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EDITORIAL NOTES—GAS, &c.

Chaos in Gas-Engine Research.

THE address, entitled "Thermodynamics and the Heat "Engine," with which Mr. Dugald Clerk inaugurated the proceedings of the Engineering Section at the recent meeting of the British Association was published, in abstract form, in last week's issue; and this week we reproduce the first part of the report of the Research Committee on "Gaseous Explosions," with special reference to the actions and interactions occuring in the cylinder of the gas-engine. The second part of the report will be given next week. Most men who are actively engaged in the work of the gas industry, and whose minds are largely occupied with the practical affairs appertaining to gas production and commerce, will regretfully turn from a perusal of the address and report with the thought uppermost in their minds that, though so many erudite minds have been engaged on the problems of the internal combustion engine, though so immense an amount of work has been done, though so much time and money have been spent, there is still considerable chaos, and therefore much to be done, and much to correct. It is, however, a vast subject—a subject of multifarious aspects, and one in the investigation of which there are many pitfalls besetting the most careful of investigators.

The question of thermodynamics has grown almost ancient; and Mr. Dugald Clerk, in his address to the Engineering Section, traced the remote history down to modern times. The address served as an apt introduction to the report of the Committee on "Gaseous Explosions" in the testimony it gave to the indecision which has prevailed, and still persists, in this particular field of scientific research, which indecision is confirmed in the analysis made by the Committee of the more modern detailed work upon phenomena of the gas-engine. But this first report of the Committee shows that their investigation will be highly valuable; inasmuch as, having regard to the peculiarly strong constitution of the Committee, they may be depended upon to rescue, for the advancement of practice and efficiency, from what has hitherto been done that which may be accepted as reliable, and so give us a firmer standing in the knowledge of the fascinating problems the solution of which alone can enable material headway to be made. Their work will be, as it has been already, alike constructive and destructive—destructive of misapprehension, of baseless hypothesis, and of past error. We say this with confidence, as, again having regard to the *personnel* of the Committee—comprising as it does physicists, chemists, and engineers of high standing, and all specially qualified in this work—the reconciliation of their views in a unanimous conclusive report will serve as a guarantee that has not hitherto obtained.

Their report up to the point they have gone at once produces faith, and also raises doubt as to the acceptance of much of the painstaking work that has been done in the past and the proffered theories of the workers. Discussion of results obtained in past work has led the Committee to the conclusion that "a large number of the observations must "have been affected by systematic or other errors, and that "re-determinations are very necessary." In fact, the errors assume, when brought under serious and formal consideration, a greater magnitude than when presented in isolated state and without rigid comparison. We have Professor Callendar showing that certain measurements—made by men whose names live in memory for their arduous work in unravelling mysteries in the realm of physical science—in connection with this subject are not acceptable, that many of the specific heat values given by them are much too low. Incidentally, here comes one tribute to the value of the Committee's work. To what degree of accuracy, an inquirer asked the Chairman of the Section, do the Committee think they have attained in ascertaining the specific heat of a gaseous mixture after explosion; and Mr. Dugald Clerk's reply was to within 5 per cent., and it is hoped to put the matter on a much firmer basis by a continuation of the work. Further, as to the errors of the past. Recent researches on the properties of gases at high temperatures have definitely shown that the assumption of constant specific heat is erroneous; and there are really no reliable data regarding the unaccounted-for heat, lost to the walls of the cylinder or suppressed owing to incomplete combustion. The time-honoured air standard, as representing ideal efficiency, has been knocked from its pedestal. It is now almost generally—though this has been recently controverted—accepted that its application is incorrect, as owing (using words of Captain Sankey) "to the increase of specific heat with temperature, "the ideal efficiency is lower than the air standard." The air standard is therefore of no practical value in the design of the internal combustion engine. And so we go on, finding discrepancy and inconsistency that shatter greatly one's confidence in the value of much of the research work—copied and perpetuated by successive workers—of past times. Verily, it is high time that systematic investigation was made, to bring about definite conclusion, and to solve the problems still awaiting solution.

Enlightening as has been much of the work of the past into the problems of the internal combustion engine, the chaos with which we are surrounded is unquestionably due to the ruts of individualism, without sufficient contemporary interest to guide or to apply the brake. The individual may do much; we applaud and support his work. But the individual may get much out to sea, without he is subject to helpful direction from the collective judgment of qualified compeers. And, moreover, the special work now under consideration has been largely conducted by physicists and chemists independent of practical men. To an extent, the practical man has been kept at arm's length by the location of the experimental work, and even by the ultimate method of communicating results and the modes of expression, which requires of him for full comprehension that he should wing himself beyond the practical sphere in which he now lives. Furthermore, the modes of expression have not had consonance as between worker and worker. We have this hinted at in one part of the report of the Committee, in which they point out that the results of experiments on the energy of gases have been expressed in the form of tables or formulæ giving the specific heats in terms of the temperature; while it would appear preferable for most purposes to have expressed them in terms of unit volume. That is clearly the form most convenient for the purposes of thermodynamic calculation; and it has the further advantage that it expresses the actual quantity measured. There would, indeed, be great value if the physicists and chemists who devote themselves to this particular research would iron-out their discrepancies in expression, and produce simplification by adopting suitable comprehensive terms that would signify exactly what is meant, and so encourage the interest and sympathy of practical engineers. The fact of the matter is they have always carried themselves above the heads of the practical engineer, who collects, as a consequence, very little cream from their work, and is debarred from active participation by the (to him) somewhat lugubrious academical and ofttimes pedantic theses that are published. The merely "partial "enlightenment" of the richly mentally endowed Siemens in 1853 (to which Mr. Dugald Clerk refers in his address), regarding the addition of heat to a working fluid, so raising its temperature, and the impossibility, even if expansion took place until the original temperature was reached, of realizing the entire mechanical equivalent, is an illustration of—the necessary changes in the state of knowledge of the times being made—the continuing incomplete appreciation of the practical engineer of the higher problems clustering around the internal combustion engine.

We repeat that the reason for this is that the physicist

and the chemist have made of these problems a field of work much their own, without any close association with the practical engineer. This is seen in the discussions of papers and reports on gas-engine research work, when only a choice few are in the position of contributing anything worth listening to, though even then largely expressed in a style above the heads of the engineers who have little or no opportunity of making themselves intimately conversant with the problems under consideration. But this state of scientific exclusiveness should not be in future; and we do most heartily endorse Dr. Glazebrook's opinion that, though the questions requiring answer are mainly physical and chemical, the problems ought hereafter to be attacked on engineering lines. There are many such questions requiring elucidation; and we do hope that nothing will be imposed to prevent the Committee prosecuting the sifting and elucidating work now so well begun. We want—no one more than those interested in the gas industry—to attain in the practical working of gas-engines to the highest possible degree of efficiency and economy; and, by the aid of the scientist, some of the present losses, due to unequal temperature, imperfect combustion, eddies and wave motion, cylinder radiation, and so forth, should be recoverable. But, let the lines of the work be of a nature, and the presentment of it of a character, that the practical engineer can, during its progress, take a live interest in it. Had this been so in the past, so much error might not have survived so long as it has done in the garb of truth. While practical men are in need of the work of the scientist, the scientist is just as much in need of the work of the practical man. Let them not deceive themselves. Between them there should be a conflux of work. Where there is not, there is delay.

Useful Technical Education.

If readers have not already perused the Presidential Address of Professor L. C. Miall to the Educational Science Section of the British Association at the recent meeting, we heartily commend it to their notice; and for present purposes, the brief summary of it given in another part of the present issue, may perhaps suffice. The whole address is to our mind one of illuminating common sense, applied to what is undoubtedly, and increasingly, the most important question of the day, and for the nation. What to teach and how to teach—these are fundamental problems that go to the root of a people's well-being and progress. Upon the way in which they are answered in actual practice, depends the future. Strength of arms will no longer suffice a nation if the trained brain does not go with it; for the battle of to-morrow will not be on land or sea, but in the regions of art and science and in the fields of industry and commerce.

To equip the younger generation aright for this conflict of to-morrow is the arduous and responsible duty devolving upon the teacher of to-day; and the teacher is to be found not only in our schools, but in every walk of life where master and pupil, chief and assistant, are met with. Professor Miall points the way along sound lines. He recognizes the vast difference between useful knowledge and the knowledge of useful things. His whole address is a strong and eloquent plea to educationists to aim at the former alone—the imparting of real, vital, sound wisdom leading to complete mental equipment and discipline, as against the hollow, inessential, vain cramming of information resulting in mental chaos and confusion—though, perhaps, with a temporary examination success. Real, useful knowledge, not mere accumulation of items of useful information—this is what is urged.

It is obvious that such being the desirable course, to effect it through the medium of what is known as technical education, is an exceedingly difficult task. The professor says that such education can be carried out in three ways; but there is really only one of them which is to be recommended. That is, "to qualify the pupil for his calling by a thorough "training in some science or art, and then by the application, "under the guidance of an expert, of that science or art to "a particular industry." We are happy to think that this method is now the one generally recognized by members of the gas profession. The second way, which really cannot too strongly be condemned, "aims at no more than supplying "information directly applicable to the industry in question." Under this deplorable method, the future gas engineer—who would be that only in name—would be nursed solely on data applicable to the gas industry, probably entering a gas-works at the age of fourteen. Professor Miall truly says in this case: "The information is not accurately lodged either in the memory "or in the note-books of the students." Who, in going through his professional career, has not met and worked alongside the assistant or draughtsman whose sole idea seemed to be to crowd into his note-book a vast collection of miscellanea? Without the proper preliminary, scientific, and mental training, of what use were they? They were ill-digested, misunderstood, and altogether unprofitable and useless. The third method "aims at nothing more than facility by repeti- "tion." In this category, Professor Miall would place such a practical art as cookery—largely acquired by imitation and constant practice. Limiting "cookery" to the infinitely more general and useful application of it, we suppose there can be no denying that it can be sufficiently taught and practised by imitation and repetition. But we rather demur to restricting such arts as needlework and cookery to this domestic sphere; and in so far as they are raised by exponents of exceptional ability out of the more homely routine, so we think these exponents would need to have undergone the technical educational method rightly placed first.

He who has been properly and naturally (as distinct from artificially) educated—whether technically or not—will be able fully to appreciate the truth of Professor Miall's assertion that "natural education is only kept alive by doing;" and that "mastery does not come by listening while some- "body explains; it is the reward of effort." There is a saying of some learned judge that barristers-at-law should know something of everything, and everything of something. This may be rightly also applied to those practising gas engineering and other callings. Education—again, whether technical or not—should give a broad outlook on life, sanely and whole, and, at the same time, in these days of specialization in all departments, the complete mastery of some one thing or branch. Only in this way can the coming race of gas engineers fit themselves worthily to uphold, and carry still further, the great efforts in doing, and the high traditions and character of the best of their predecessors.

Socialistic Romancing.

The Trade Union Congress has just been held, and another demonstration added to the long list of precursors of the vain, arrogant, and irresponsible chatter of the leading labour extremists who act as delegates of certain Trade Unions on the occasion, but who, we are glad to think, grossly misrepresent the intelligently thinking working men of the country. For this annual event "Trades Union "Congress" is now a misnomer; the Congress having been delivered, body and soul, over to the Socialists, who lord it finely, whether or not it be admitted, over the less pugnacious and sober-minded delegates. They now prate of a growing matchless political power as a class, and of strength accruing which will enable them to constitute a legislative chamber after their own hearts, and compel the House of Lords to obedience. But meantime, all these strange predictions being still in vaporous condition, legitimate Trade Union topics are now dropped at the Annual Congress, and politics neither pure nor simple have practically sole place in the proceedings. Perfect shoals of resolutions are proposed and carried, each one covering a demand for the redress of some supposed grievance, or for conferring new privileges or so-called rights; and "instructions" are given, with ease and freedom, for the promotion of legislation to benefit the one class without the slightest care as to whether the scheme the measure is to frame will do an injustice or impose hardship on another class. The fact of the matter is that nothing short of complete possession would prevent these initiators of wild schemes from persisting in supplying the evidence of an extravagance carried to the level of eccentricity. But while they "demand" and "instruct," they decline to return thanks for concession. They refuse even to thank the Government for the introductory scheme of old-age pensions; and when the Prime Minister, Mr. Lloyd-George, and other of their colleagues in the Cabinet remember the self-advertised benevolent spirit in which they projected and carried through the non-contributory scheme, they will feel keenly the cut of their callous socialistic allies who cheered loudly at the statement that labour had "wrung" the scheme out of the Government, and intends goading them into a tractable condition to remove its (to the Socialists) too tightly laced restrictions.

While, however, the Congress in such matters was not in a thankful mood, and showed in this and several other ways little refinement and culture, they did indicate their appreciation of the value of the latter by asking the State to be good

enough to take upon itself—thus lightening parental responsibilities—the maintenance of school children, their free education, and medical requirements, with an extension of the scholarship system in connection with secondary and technical education. Naturally, too, the unemployed question bulked largely in the proceedings. The President (Mr. D. J. Shackleton, M.P.) can think of nothing better as a palliative than the ancient and much-favoured plan of the less-work-and-more-pay advocates; and the delegates voted heavily for a eight-hour day limitation in all industries. But there is a desire to have two strings to the bow; and a resolution was passed recording the opinion that the time has now arrived when the Government must make provision for the purpose of finding work of public utility for all sections of unemployed men and women. The Congress only recognized one alternative if the Government herein fail; and that is that the Government must make grants to the Trade Unions for them to dispense in support of the members who are out of work. It is difficult to suppress amusement, especially when one delegate intimated to the labour members of Parliament that these things are easy of accomplishment. All that has to be done is "to strike fear "into the hearts of the legislators of the country."

There is no intention, however, that labour legislation shall be left either to this inhuman mode of procedure or to chance. A Bill is to be formulated for the establishment of a Department of Labour, with a Minister of Cabinet rank at the head. It is not explained why labour more than any other class of the community should have this privilege in representation; and other sections of the community are left to their own devices in searching for a reason. In addition to these topics, there were the hardy annuals as to the payment of members of Parliament, nationalization of railways, canals, &c.; and a rejection once more of the principles of compulsory arbitration. We are glad to see in the prolixity—wordy and quixotic—of the occasion, that two or three of the speakers recognized that peaceful political conduct will make faster than attempted violence the pace of so-called "reform." Our old-time friend Will Thorne—boisterous and extravagant though he is at times—in stating one of the causes of unemployment as being the speeding-up of machinery and the introduction of scientific inventions, and pointing out that eventually the workers would have to tackle this question of machinery, made the explanation that "he did not mean, as some people imagined, the destruction "of the machinery such as occurred in the old days. His "meaning was they should capture the machinery, and have "it worked for the benefit of the whole community." We will not trouble to say many things that might obviously be said on this explanation; but it is a satisfaction to be able to recognize that some of the delegates at the Congress do not lose their equilibrium on all subjects.

Sulphate of Ammonia Committee.

THROUGH inadvertence on our part, there has been delay in the publication in these columns of the annual report of the Sulphate of Ammonia Committee; but amends for the neglect is made to-day by the reproduction of the main portions in our "Miscellaneous News." Two pronounced features of the report are exceedingly satisfactory. The one is that during the year ending June last, the Committee gained substantially in strength; the other, that the activity of the Executive in their propagative work continued at the high level which has now been witnessed for several years. Touching the first point, the fresh subscribers enrolled numbered 34; their aggregate estimated annual production being 7500 tons of sulphate of ammonia. In addition, the subscriptions for the year represented the further material increase of 12,800 in the gross tonnage of the contributing manufacturers. These figures are highly gratifying and encouraging; and they are a sign that a greater number of producers see the wisdom and the justice of contributing to an educational and advertising campaign in favour of a commodity assailed by very active competition. We trust that the enrolment will continue, until all sulphate of ammonia producers—their interest being a common one—will be leagued together in the prosecution of the work now so well carried on for several years. It may be that market prices do not show great variation; but it is something to expand demand and, in face of strenuous rivalry, to maintain good prices. The work of propagating knowledge and interest has during the year been on lines similar to those followed previously. No less than 78 competitions have been held for prizes in connection with crops grown by the aid of sulphate of ammonia; there have been exhibits at several agricultural shows; advertisement of merits in agricultural organs and in other ways has been made; literature has been circulated; and a crop-growing demonstration similar to that at the Irish Exhibition is now being conducted at the Scottish National Exhibition in Edinburgh. The record of work for the year is excellent; and the year into which we are advancing promises equally well.

An Electric Spark and an Explosive Mixture.

THE grim results, in loss of human life and infliction of suffering, of the explosion of the airship at the Franco-British Exhibition on Aug. 14 have drawn a large amount of public attention to the event, and there has been a strong desire to learn the actual cause of the disaster. At one time, it seemed probable that the manner of the ignition of the explosive mixture would only be, after all inquiry had been made, inferentially ascribed. But the inquest on the victims has been held; and there is now no shadow of doubt that the sparking of an electrically driven fan was the cause of the fearful mischief. The gas bag or balloon of the air-ship had a capacity of about 10,000 cubic feet; and it will be remembered that it was inflated with hydrogen gas produced by a special plant. The air-ship was housed in a large tent, lighted by incandescent electric lamps, and ventilated by electric fans. One of the latter was also used for inflating the balloon with air to allow of the inspection of the fabric; and on this occasion it was also employed for supplementing with air the deficient hydrogen contents of the balloon. Upon this point, there is no disagreement in the evidence; but there is a variation in the testimony as to the amount of air that was forced into the balloon under the circumstances. This is, from the scientific standpoint, regrettable; but the disaster prompts the belief that error is rather on the side of the smaller proportion of air than the larger.

The owner of the airship (Captain Lovelace) stated that there was from 9000 to 9500 cubic feet of hydrogen gas in the balloon on the morning of the accident, and that only 500 to 800 cubic feet of air were pumped in to fully inflate the bag. One of the other witnesses stated that the balloon was only two-thirds full; that it was pumped tight with air; and that the pumping continued for at least half an hour. The fan was a small one, but the time occupied suggests that the proportion of air to hydrogen in the balloon was greater than (doubtless in all honesty) was believed by the owner. There is another point. The very low specific gravity of hydrogen gas leads Captain Lovelace to think that it was stored at the top of the gas bag, and the air cushioned against it at the bottom, and that in the neck of the balloon there was practically pure air. But against this hypothesis of an almost definite stratification, there is the well-known great diffusibility of hydrogen gas, which is proved by the elementary experiment with a jar of hydrogen and a jar of air with their openings one over the other, in which transmigration takes place until there is a uniform mixture in the two jars. The disturbance caused by the pumping of the air into the neck of the balloon by a fan would hasten the diffusion; and that diffusion had taken place is abundantly clear from the explosion. It is therefore plain that the first factor in the creation of a dangerous set of conditions here was the forcing of air into the balloon containing hydrogen gas, and the second was the use of an electric fan for introducing the air.

The electrical and mechanical appliances, it appears, had all been inspected by a responsible official of the London County Council; and he was satisfied with the arrangements. But having regard to the character of hydrogen gas, and the fact that, though the electric fan was of good make, there is sometimes sparking in the brushes and always at the switching-off, the use of the fans in such a position should have been prohibited. In justice, however, it should be said that the London County Council officials were not aware that an electric fan would be employed for driving air into a balloon already containing several thousand cubic feet of hydrogen gas. There may have been disobedience to orders in resuming the use of the fan after instructions had been given to discontinue pumping air into the balloon; but that does not alter the fact that, in places where the possibility exists for the accumulation of explosive mixtures, there electric fans and motors should be absolutely interdicted. They are used to-day in many such places; it rests upon the users to take the necessary steps to guard against disaster.

Seeking New Sources of Taxation.

Owing to various causes—prominent among which must no doubt be placed the fact of her marvellously rapid growth as an industrial nation, and the natural desire to retain her position as a military power—Germany has of recent years been piling up her liabilities in a manner which manifestly could not be continued for ever; and of late several attempts have been made to readjust the finances of the country. However, things have still gone on in the same way, until now the urgent necessity has been forced upon those in authority of doing something to more nearly balance the national income and expenditure. To this end, it seems that various economies are to be proposed, along with the imposition of new taxes. Accounts to hand state that one of these fresh sources of taxation will be gas and electricity that is used for lighting purposes; and it is also remarked that the consumers will pay this tax, and not the producers. But, of course, in the long run it is bound in any event to be the consumers who will pay—just as in this country the consumers have to pay the taxes that are imposed on gas companies by local authorities. Some consolation will doubtless be felt by the poorer classes in the assurance that small traders and consumers will be considered—the burden falling upon them being relatively smaller than that which will be imposed on large consumers. A Government tax on artificial light is, however, sure to affect everyone more or less, though it will be calculated to raise up many earnest disciples in Germany of the "daylight saving" idea.

Electric-Motor and Gas-Engine Breakdowns.

Though failures and accidents are at all times regrettable, there is never any disappointment in turning for instruction to the annual report of Mr. Michael Longridge, M.A., M.Inst.C.E., Chief Engineer of the British Engine, Boiler, and Electrical Insurance Company, Limited. The portion of the contents of the one referring to 1907 that specially appeals to gas engineers and users of gas-engines has been reviewed by us; and the first part of the review is published in this issue. Among other sections of the report, is one dealing with electric dynamos and motors. The insinuated infallibility of electric motors is so often seen in the advertising literature of electricity stations, that it serves to break the monotony of the persistent tale to learn from the report that the breakdowns of dynamos and motors with which the Company had to deal in 1907 exceeded those of 1906 by 18·1 per cent. in number, and by 16·3 per cent. in cost. This fact proves that the insurance of electric machinery is a benefit to the user; and the report indicates the appreciation of this among those mainly concerned. When the gas-engine driving the printing-machine of a country newspaper breaks down through inattention, and the electrical engineer puts on a spurt and gets an electric motor installed at short notice, he publishes the fact to the whole world; and the weekly electrical papers and the electrical bulletins in unison laud the heroic deed and the safety and reliability of the motor. What is said in the hour of jubilation does not always receive confirmation in practice. In 1907, says Mr. Longridge, the rate of breakdown was rather lower among dynamos and rather higher among motors than in 1906. The exact figures are 1 in 18·7 among dynamos, and 1 in 7·9 among motors. The corresponding figures for 1906 were 1 in 16 and 1 in 8·2. Among gas and oil engines last year, the rate of breakdown was 1 in 11·1; in 1906, it was 1 in 12·4. This is the comment and the excuse made by the "Electrician" on the point: "The figures for motors and gas [and oil] engines—viz., 1 in 7·9 and 1 in 11·1 respectively—*appear* strongly in favour of the gas-engine as being the more reliable machine; but it must be remembered that the electric motor is generally placed in close proximity to the machine it drives, and under most adverse conditions, and, being frequently out of sight, or nearly so, receives but scant attention as compared with the gas-engine." But the motors, like the gas-engines, come under the periodical inspection of the officers of the Insurance Company; and the fact remains that the percentage rate of breakdowns of motors and of users put to inconvenience is larger. However, the point need not be pursued, except to say that the report of Mr. Longridge only takes account of the mechanical breakdowns, and not the breakdowns occasioned by stoppage of current and the external troubles associated with the electricity supply system. There is one other remark of the Chief Engineer of the Company that is worth noting. As in the preceding year, the rate of breakdowns among continuous current machines was much higher than among alternating ones; but on the other hand, the average cost of the breakdowns was much less.

Sir Frederick Mappin's Retirement.

The predominant feature of last week's meeting of the Sheffield United Gas Company (a report of the proceedings at which will be found on another page) was certainly the regretful announcement that Sir Frederick Mappin, on account of advancing years, has felt obliged to relinquish the post of Chairman of the Company—a position which, it may be remarked, he has occupied, with credit to himself and advantage to the Company, for a very long time past. The great amount of time and attention he has devoted to the business during the 35½ years he has been Chairman is well known to all who are in any way connected with the Company; and his thorough grasp of all matters bearing upon the welfare of the industry has been appreciated by readers of the "JOURNAL" and others who have made a point of studying the speeches he made at h..lf-yearly meetings of shareholders—speeches which invariably possessed features of interest beyond the circle comprised of the proprietors of the particular undertaking over which he presided. But now the laws of Nature, to which all are amenable, have compelled his retirement from the chair, though the benefit of his services, both to the undertaking and to the consumers, will remain. In emulating him, Sir Frederick's successor—Mr. Wilson Mappin—will have a difficult task to perform; but he has, during his father's illness, already had an opportunity of proving his intention to devote himself heart and soul to the service of the Company. The proprietors will be glad to think Sir Frederick still remains on the Board as a Director; and both they and his many other friends, in the gas industry and outside of it, will rejoice to know that he is now enjoying considerably better health than has recently been the case.

Progress at Sheffield.

The statement of affairs which Mr. Wilson Mappin yesterday week had to lay before the shareholders of the Sheffield Gas Company, in his new position of Chairman, was a very gratifying one—beginning, as it did, with the announcement that there had been an increase in the quantity of gas sold during the past six months, compared with the corresponding period of last year, of about 6½ per cent. As he remarked, this is the more pleasing when it is remembered that it follows other considerable jumps in consumption—the total increase in the past three years having amounted to over 23 per cent. This continual growth, of course, is made possible by, and has made possible, the cheap supply of gas which the Company's consumers enjoy—the average price received during the past six months under the differential scale of charges in operation having been slightly under 1s. 3d. per 1000 cubic feet. The greater business done on this occasion, however, as in many other cases, has not resulted in increased profit, owing to the large extra amount that has had to be paid for coal; and something has had to be taken from the balance brought forward in order to make up the sum required for dividend. An addition of over £22,000 to the coal bill of a single half year is, of course, a serious matter; but it is one which will no doubt right itself in due season. In the meantime, a point of interest about the gas consumption is the fact that during the past six months 35 additional gas-engines have been fixed, varying in size from ½ to 150 horse power. This is an indication of the widely different circumstances in which coal gas, when obtainable at a low price, is found desirable as a motive power. Turning further to Mr. Mappin's speech, it will be seen that he compared the rates paid by the municipal electricity and other undertakings with those exacted from the Company. The advantages which publicly owned electric lighting concerns enjoy in this respect in their competition with gas companies have often been pointed out. It seems that in Sheffield the Gas Company pay in rates more that eleven times as much as is charged to the electricity undertaking; while the Water, Tramways, and Electricity Departments together, which have a combined capital more than four times that of the Gas Company, pay only £21,658 in rates, as against the latter's £18,251. Mr. Mappin pointed out that of every shilling the consumers pay for gas, 1·06d. goes for rates. They would probably be interested to know the exact proportion similarly contributed by users of municipal electricity.

Income-Tax on Municipal Profits.

The vexed question of the payment of income-tax on the profits of municipal undertakings has been raised in two parts of the country during the past few days. One instance has occurred at Malvern, where, as will be seen from the notice of his report which appears in another column, the District Auditor has attacked the policy of the Council in charging themselves for gas used for public lighting and supplied to other departments of the Council anything more than the bare cost of manufacture, distribution, and repair charges, &c.—which is 1s. 6d. per 1000 cubic feet. At present the price charged for such gas is 2s. 10d. per 1000 feet; the difference being accounted for by the inclusion of capital charges. By adopting his suggestion, he says, £50 a year in income-tax will be saved. His argument is that the Council cannot make a profit out of themselves; and that their object should be to leave undisturbed the cash profit they make from supplying other gas consumers. The question is an involved one, mainly on account of this difficulty of "making a profit out of themselves," which must apply to some extent to the ordinary consumers as well as to the Council. It may be pointed out, however, that if the idea is to avoid the payment of income-tax, there is an alternative suggestion which is contained in the report of the Elective Auditors of the Borough of Wigan, who, dealing with the accounts for the year to March 31 last, say: "We paid income-tax on the profits of the Gas Department of £830 11s. If gas was reduced to consumers, this amount need not be paid." In this way, the benefit would be general, and the consumers would not have the uncomfortable feeling that they were in some way assisting to pay the rates of those who did not use gas.

The Starting of the New Verticals at Mariendorf.

An innovation worthy of imitation has been introduced by the Imperial Continental Gas Association at Berlin. The new bench of vertical retorts at Mariendorf is to be brought into action, and on this occasion the heat has to be regulated in such a way that all the bottom flues between the retorts attain the same uniform high heat, which decreases gradually as the furnace gases pass towards the top of the retort-bench. The regulation once attained, the furnaces keep in the same condition for a long time, and only want the merest touch now and then. But it is essential for the safe and effective working of vertical retorts that the new principle of regulation, which is simple and ingenious, should be perfectly understood by those responsible for them. The Association have, in consequence, issued invitations to all German gas-works which have decided on the adoption of verticals (the Corporations of Berlin and Charlottenburg among the others), to send a number of engineers and foremen to Mariendorf, where every opportunity will be afforded them of getting acquainted with the Association's methods of retort-house practice. These have been so far very successful. The Oberspree furnaces have been in action since February, 1907, and the Mariendorf ones since September, 1907; but there is not a single hole nor the slightest deformation in any of the retorts, so that the coke slides out as automatically as at first. The expectations entertained by Mr. Edward Körting, that the verticals, over and above their other advantages, would with judicious treatment also show considerable economy in wear and tear, seem therefore to be on the point of being corroborated by experience.

Monazite Sand.

According to reports received from Brazil, it appears that the position of the export of monazite sand (the most important material for the manufacture of incandescent mantles) has experienced a great change, in consequence of recent events. For several years past the raw material has been imported into Europe by a Hamburg firm who had contracts with the Brazilian Government, and also by an American who privately owned some of the fields. Heavy export taxes rendered the export by other firms almost impossible. Lately this has been altered. The Government of the State of Esperitu Santo—where very large privately-owned fields of monazite exist—has given permission to export the sand under more favourable conditions; and in consequence large quantities are now being shipped to Europe. Since considerable amounts were left in the hands of the two parties who previously controlled the market, it may be taken for granted that the supply of the material will now be plentiful, and remain so for the next few years. But although these new conditions are most welcome to the manufacturers of incandescent mantles, they are not at all advantageous to the German thorium manufacturers, who have in the past controlled almost exclusively the supply of the European market. In the future other firms (chiefly French and English) will, it is considered, be in a position to share in the manufacture of thorium.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 740.)

THE course of movements on the Stock Exchange last week presented the reverse of the medal exhibited the week before; for whereas that showed a recovery at the close, this was at its best in the earlier part and gave way towards the end. It need hardly be said that business was quiet, and the settlement of the account—not a very difficult one—had most attention. The opening on Monday offered some favourable features. Gilt-edged securities were higher—Consols advancing $\frac{3}{16}$ on buying orders; and several important markets were strong. But Home Rails were depressed by anxiety concerning labour agitation. The tendency on Tuesday was generally in a like direction in the markets already referred to; and Gas issues were quite firm. On Wednesday, the brighter views extended so as to embrace even Home Rails, which made a moderate recovery. In one or two lines there was some little hesitation; but nearly all (Gas included) closed higher. Thursday showed signs that the upward movement must come to an end; and the turning point was reached in some departments. But Gas issues were strong. On Friday, the retrograde movement set in; and there was a good bit of realizing—a not uncommon feature on Friday. But Gas pursued its own firm line, and Home Rails took a more hopeful view of labour questions. Saturday was a quiet day, and prices, though easier, were not largely moved. The extreme ease which has lately characterized the Money Market continued in a marked degree; and the normal demands could make no impression on the supply. Discount rates gave way slightly. Business in the Gas Market was, of course, still on the holiday scale, but not so quiet but that a good many quotations could improve on their figures. In Gaslight and Coke issues, the ordinary was moderately dealt in daily, and advanced a point, with transactions marked at from 99 to 100¼. The secured issues were quiet; the maximum changing hands at 88 and 88¾, the preference at from 105¼ to 107, and the debenture at 85½ and 86. South Metropolitan also advanced a point—dealings being marked at from 120 free to 121½. In Commercials, the 4 per cent. was done at 107½ and 108, and the 3½ per cent. at 102. In the Suburban and Provincial group, Bournemouth "B" marked 16¾, British 41½ and 42, Brentford old 247, ditto new 183 and 184¾, Tottenham "B" from 105½ to 106⅔, and West Ham 101 and 102. The Continental Companies were quiet. Imperial changed hands at from 181 to 182, Union at 110½, ditto preference at 141, and European fully-paid at 23. Among the undertakings of the remoter world, Buenos Ayres was done at from 11½ to 11⅝, Cape Town debenture stock at from 79½ to 79¾, Primitiva at from 5$\frac{13}{32}$ to 6¼, ditto preference at 5 and 5⅛, ditto debenture at 96¼, River Plate at from 15½ to 15⅝, and San Paulo at 14.

ELECTRICITY SUPPLY MEMORANDA.

The Depression in the Electrical Manufacturing Industry—Native and Exotic Competition and Cut Prices—Speaking Figures—Individual Effort the Best Remedy—Edmundson Experiences in Residential Areas—The Raison d'Etre of Power Companies and Existing Facts.

WHETHER the general trade of the country is good or bad, there is the same cry of bad times from the electrical manufacturing industry. The reports and accounts that have lately been presented to the shareholders in the plant manufacturing and contracting concerns, and the speeches of most of the chairmen at the meetings, convey the dolorous tale to which we have become accustomed by annual repetition. Those who see rifts in the cloud are the exceptions. The pessimists are in greater number than the optimists. The cause of over-competition both from native and foreign sources, and the consequent cutting of prices, is the favourite one assigned for the position; and the attempts of certain (not all) manufacturers to extricate themselves from the position meet in the result with little encouragement. Mr. Byng, of the General Electric Company, puts the position in a very serious light. Electrical engineering of the larger kind, according to him, has become unprofitable in this country; and, unless something is done, he is quite convinced that a number of the forty to fifty electrical engineering works in the country will have to shut their doors. The position he calls a "crying scandal," which should be promptly and properly investigated. A combination of manufacturers has been proposed with a view to a remedy; but while Mr. Byng agrees that such a step may result in considerable good, it is evident his opinion is that any such good can only be temporary, and that no real permanent improvement can be effected until our fiscal policy is altered. There is not the slightest doubt that our electrical manufacturers do suffer from the freedom of the foreigner in competing with him in this country, and from the unequal terms on which they are allowed to compete in other countries But fiscal reform could only produce partial relief from the particular evil from which the British electrical manufacturing industry is suffering. Not long ago, too, there was very hearty grumbling in the electrical industry over the high prices of materials, and the restriction that the high prices brought upon orders. Now that the prices have fallen considerably, Mr. Byng still finds cause for complaint. His Company, he

says, keep large stocks of materials; and the stocks they now hold were purchased in the times of high prices, and have had in consequence to be drastically written down. There is no pleasing some people. In alluding to Mr. Byng, it may be incidentally mentioned that his Company are the makers of Osram lamps; and he states that the outlook for business in these lamps is a very good one, and that the Company will soon be able to put on the market an Osram lamp produced at home. In the meantime, perhaps it is a good thing for Mr. Byng's Company that fiscal reform is still in the air, and not an actuality.

Looking in other directions, despite the fact that general trade has until lately been good, over-production and low prices are pointed to as the main causes of the continuing poorness of the position in the industry. Mr. John Trotter, of Crompton and Co., Limited, puts his finger on the same centres of evil. "They had, he said, been suffering for some years past, and were still suffering, from over-production and low prices." Edmundson's Electricity Corporation, Limited, showed a reduction in their trading profits last year; and the position of the Company is anything but a cheerful one for the shareholders. In fact, the Chairman (Mr. P. D. Tuckett) goes so far as to say that "the position of the Company was an extremely critical one, which might easily have resulted in the shareholders losing every penny they had in it." The report of the Company for last year states that the net profit, after payment of the debenture interest, amounted to only £2610, which, with the sum (£17,806) brought forward from the preceding year, gave a total balance of £20,417. The shrinkage of this Company's profits in the preceding three years tells its own tale. For the year 1905, profits were £68,822; in 1906, £59,993; in 1907, £35,538. These sums were obtained from investments and from contracting work. The yield of the investments has kept at a fairly uniform level in the three years—£30,204, £32,284, and £31,480. There is not much movement in these. But the profits from contracting work had a terrible fall in the period—viz., from £38,618 in 1905 to £27,709 in 1906, and to £4058 in 1907. After learning these results, it is not surprising to find Mr. J. B. Braithwaite, of the Electric and General Investment Company, Limited, saying that the past year had been one in which there had been little or no advance for electrical securities; and it had been a year in which electrical investment had been somewhat out of favour with the public.

Where are these electrical manufacturing concerns to look for improvement in their positions? Competition will continue. It is impossible to get all the manufacturing undertakings at home and abroad under one hat. The fluctuations in the costs of raw materials will also continue; and that is a factor affecting all alike. Effort to improve conditions must therefore begin at home. Electrical plant, from its very nature, must always be expensive to manufacture, and great care must ever be exercised in production to see that efficiency is not sacrificed. Besides this, as Colonel Crompton has very truly said, the electrical manufacturing industry has not, through the improvement that is constantly taking place, the same security in patterns and designs as have other branches of engineering. But from general observation, we do think that several of the electrical manufacturing enterprises in this country are conducted on very expensive lines. It is quite admitted that the view is formed from observation and visits to works, and not from a daily acquaintance with the routine. However, there appears to be an internal awakening on this score. By improvement of plant, and by economy without the sacrifice of efficiency, there are concerns whose administrators are filled with such hope as to induce them to look to a brighter side; and they will, if it be possible, make their way to still higher financial status from sheer force of will and work exercised within. If they do this, those who are laggard will sink deeper and deeper into the mire, and will eventually lose their existence. Mr. Trotter, at the meeting of the Crompton Company's shareholders, stated that, by improvements in design and cheaper manufacture, they are now turning out machines at lower cost. The Chairman of the Electric and Construction Company states that, in spite of severe depression in the industry, the very excellence and high quality of their goods had served them well. At the meeting of the British Thomson-Houston Company, accounts were presented that were distinctly better than those of the preceding year; and we find the Chairman remarking that this was due to improved methods of manufacture and the policy of strict economy that had been followed so far as was compatible with efficiency. This seems to point the way to improvement. Individuality will succeed faster than a combination of manufacturers called together to diagnose what is already well known, and to suggest some combined remedial treatment, which, in this case, can be of little avail against individual skill and persistent application.

The experiences are of interest of the Edmundson Company in the financing and working of electricity supply undertakings from which they have in the past made profits as contractors for the laying down of plant. We have seen above the profits made by the Company; but these profits represent an enormous capital expenditure. The local authority undertakings in which the Company are concerned were particularly referred to by the Chairman at the meeting of the shareholders; the loss on them having been £295 greater than the preceding year, owing to the decreased profit realized at Cromer, Dorking, and Frome. We have seen some of the paltry advertising literature for which the Edmundson Company are responsible that has been circulated among householders at these places; and we are not in consequence surprised at the slow progress made. At Dorking, the Chairman stated, they were likely to do somewhat better during the current year. They anticipated, too, a steady improvement at Hamilton and Surbiton; but he regretted to say the prospects at Cromer and Frome were very discouraging. What follows is worth reprinting *in extenso*:

> The actual loss in the case of these towns was brought about owing to the obligation of the Company to provide not less than 6¼ per cent. by way of interest and sinking fund on the capital provided by the respective local authorities; so that, as they earned less than 3 per cent. in the case of Cromer and Frome, and little more than 3 per cent. in the case of Hamilton, and in no case as much as 6¼ per cent., it followed that there was a very substantial deficiency to be made good.

Certain of the Company undertakings in which the Edmundson shareholders are interested also showed decreased gross profits last year. These experiences have their salutary lessons; but local authorities and investors when small residential districts are proposed to be exploited by electricity, do not consider the past, but prefer to pay dearly for experiences of their own. One other point. The Lancashire Power Company are sometimes held up for admiration as a pushing and progressive power undertaking. This is what the Chairman of Edmundson's says about it: "The Board were not anxious to put further money into the Company; and he had no doubt that the past Directors were sorry that they could not go back on their decision, and recover the money put into it." The remark requires no comment to enforce its meaning.

This allusion to the Lancashire Power Company paves the way to a reference to a suggestive article that has lately appeared in the "Electrician" on the contradictory state of affairs that the conditions of bulk supply in this country present at the present time. Our contemporary will not object if we acknowledge that what is said hereafter is composed almost entirely of sentences culled from their article: Originally power-in-bulk companies obtained parliamentary powers to generate electrical energy in large central stations, and distribute it over wide areas. The principal argument advanced in favour of these schemes was the low operating costs which were realizable in power houses in which were concentrated a small number of units of large output. An important principle was enunciated; and the stations were started in due course to give it practical effect. Isolated power plants for the generation of electric power were henceforth to be abandoned; and the power-in-bulk supply was to be taken from the company operating in the particular area. Theoretically, the ultimate result of the logical pursuit of this policy would be the removal of steam, oil, and gas plants in industrial establishments within the area of bulk supply, and their displacement by electric motors. Also, it would follow as a natural consequence that no further business in the sale of such engines, &c., could be obtained in those districts covered by the mains of a power company. In a word, there would be ultimately no room for isolated plants in the supply area of a power-in-bulk company. From the point of view of the manufacturers of boilers, steam, oil, and gas engines and the numerous accessories connected therewith, there is, or should have been, nothing more to interest them in a power supply area. We notice at the present time what may be termed a heterodox movement in favour of isolated plants, even in the areas of power-in-bulk companies. This is a "reversion to type" which we regard as being most unwelcome. It indicates a lack of confidence in plant concentration, which strikes heavily at the very principle of power supply. What happens outside the power area does not affect the argument. Within the area, it is a reflection on the power supply if prime movers other than those at the various generating stations are laid down for the driving of dynamo-electric machinery. The problem is, of course, one of competition between the power-in-bulk concerns and isolated power plants; it being a question whether the particular power consumers can make their own electrical energy more cheaply than they can purchase it. One is compelled to ask, in face of this condition of things, if there is any real economy in the concentrated plant, with its ramifications of feeder lines about a large industrial area.

Professor Drehschmidt on the Public Lighting of Berlin.—In the course of the report of the discussion on Professor Drehschmidt's lecture to the German Gas and Water Association, on "Inverted High-Pressure Gas-Lamps for Public Lighting in Berlin," which appeared in the "JOURNAL" for the 1st inst. (p. 585), it was stated that Mr. H. J. Trautmann, one of the speakers, who represented the James Keith and Blackman Company, Limited, was of Cologne. We have since learned that Mr. Trautmann, who is one of the Directors of the Company, resides in London.

Proposed New Taxes in Germany.—New sources of taxation are apparently being sought in Germany, with the object of making the income more nearly approach the national expenditure than has recently been the case. The Berlin correspondent of the "Daily Chronicle" states that it is authoritatively announced in the "Lokalanzeiger" that the taxation of gas and electricity is certainly among the schemes which the Secretary of the Treasury will shortly lay before the Reichstag. It is remarked that the taxation will not fall on the power, but on the light; and that the consumers of gas and electricity will pay the tax, and not the producers. Small traders and consumers will be considered; the burden on them being relatively smaller than that which will be imposed on large consumers.

ILLUSTRATIONS OF THE HAMBURG CARBONIZING CHAMBERS.

In the last issue of the "Journal" (p. 635), we referred to M. Marquisan's researches in the literature relating to new processes in the carbonization of coal, and mentioned his reference to Dr. Lessing's contribution to the "Journal" of July 14 (p. 94) on the subject of the carbonizing chambers at the Grasbrook Gas-Works, at Hamburg. We are now enabled to give five views of the latter installation, which will be of interest to those who have not been able to visit Hamburg to see for themselves. It will be as well, perhaps, first to summarize the particulars relating to each photograph.

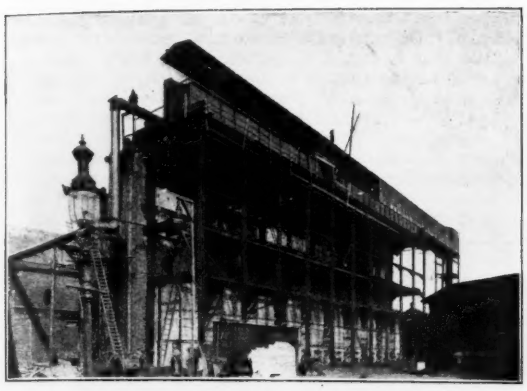

Fig. 1.—The Charging Side of Ten Settings of Gas-Ovens at the Grasbrook (Hamburg) Gas-Works.

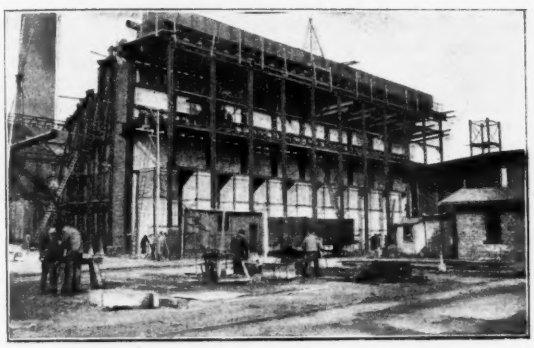

Fig. 2.—View of Same from the Other End of the Bench.

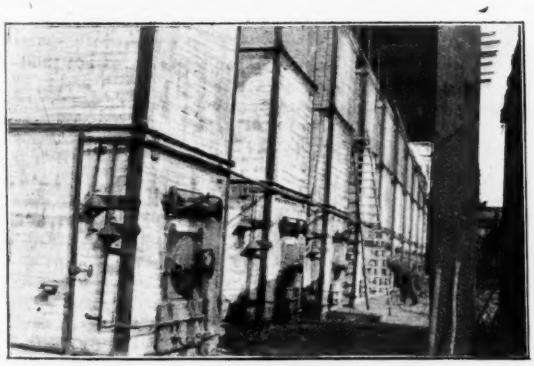

Fig. 3.—The Lower Part of the Producers—about 20 ft. 6 in. high.

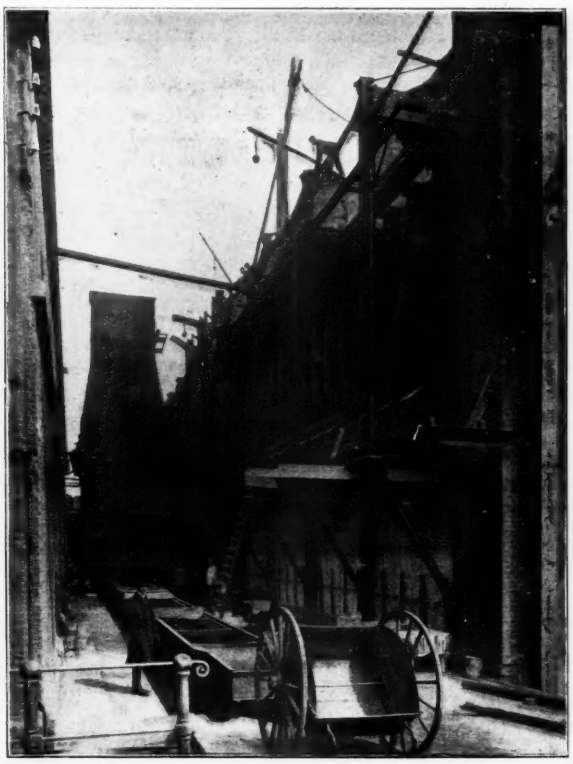

Fig. 4.—Travelling Coke-Quenching Tower and the De Brouwer Coke-Conveyor.

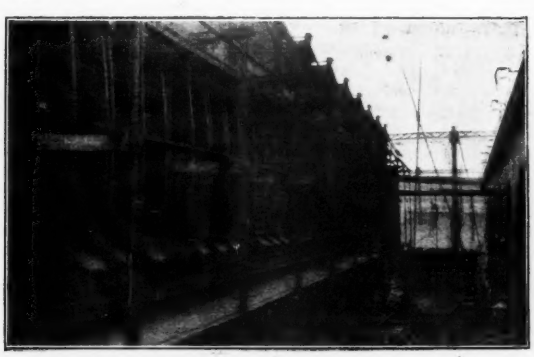

Fig. 5.—Upper View of the Gas Ovens on the Discharging Side.

It will be observed that the photographs show the installation as it was nearing completion; and indications of the erection going on are apparent. It will also be borne in mind that the carbonizing chambers (or gas-ovens as we would prefer to call them, for they are the counterpart, as it were, of coke-ovens) are at present the largest installation of the kind, and have only been in operation since the beginning of June last.

Figs. 1 and 2 give views, taken from opposite ends of the plant, on the producer and charging side, of the ten settings, each consisting of three chambers or ovens. There is no house covering them; and as Dr. Lessing says, they look like very high coke-ovens. To the roof of the coal-bunkers—clearly seen in fig. 1—is 65 feet from the ground level. The chambers are at an angle of about 36°. They are 24·6 feet long on the incline, or 21 ft. 6 in. measured on the horizontal. The width of each outside chamber in each bed is 1·8 feet; while the middle one is 2 feet wide. From the bottom of the chamber to the top of its arch is 7·4 feet, or 9·2 feet measured on the cross-section. The coal-bunkers are filled by an elevator; and the chambers are charged through a door 2 ft. 6 in. high by 1·3 feet wide, from a travelling suspended shoot, or on what is sometimes known as the coal-scuttle system of charging, as has been in use on some German settings of inclined retorts. On the charging side and at the bottom of the chamber—that is, underneath the charging door—is the discharging door, 1·8 feet high by 1·3 feet wide, through which the pusher works.

Fig. 3 gives a larger detail of the lower part of the producers, which are on the charging side of the bench, and are about 20 ft. 6 in. high.

Figs. 4 and 5 are photographs taken on the discharging or drawing side of the bench. The coke falls, or is pushed, through a door 9·2 feet high, having a width of 1·8 feet for each of the two outer chambers, and of 2 feet for the middle one. The high tower seen in fig. 4 is the quenching tower, which travels along on a wide track, and carries off all the steam. Below it is the wide De Brouwer coke-conveyor.

It may be added that the average charge of coal treated per bed of three chambers is no less than 17 tons; so that a great bulk of coke has to be dealt with by the conveyor, which has answered all expectations.

COMPARATIVE TRIALS OF MUNICH CARBONIZING CHAMBERS AND DESSAU VERTICAL RETORTS

Herr H. Ries referred in the paper which he read at the meeting of the German Association of Gas and Water Engineers at Berlin in June last to comparative trials which had been made on behalf of the Berlin gas undertaking of the carbonization of coals similar to those used at the Berlin works in both the Munich carbonizing chambers and in Dessau vertical retorts.* The trials in question were made under the supervision of Professor H. Drehschmidt, Chemist to the Berlin gas undertaking—as to the carbonizing chambers, at the Munich Gas-Works, as to the vertical retorts, in an experimental installation at the Berlin Gas-Works. The results were quoted by him at the German meeting; and a summary was given in the "Journal" for June 30 (p. 927). The figures have since been published in the "Journal für Gasbeleuchtung," together with some explanatory remarks by Professor Drehschmidt, of which the following is a digest.

The trials were undertaken on behalf of the Berlin Corporation with a view to deciding whether vertical retorts or carbonizing chambers would be most suitable for adoption in future. Much had been published in regard to the former; but as to the latter, there were only available the figures obtained by Professor Bunte last year.† It is true much had been written about carbonizing chambers; but it had been of a partisan nature, and not based on any fresh data. Hence it was thought desirable to institute direct comparisons of the duty of the two types of carbonizers, and especially with the same classes of coal in each. The Municipal Gas-Works at Berlin ordinarily carbonize a mixture of Silesian and English coal; and it was decided to use for the trials a mixture of typical varieties of these coals. The Silesian coal selected was that from the Königin Louise pit; and it was mixed with an equal quantity of Ravensworth, or Silkstone, or Lambton coal. A sufficient quantity of the coals was sent to Munich from the Berlin works, and samples were taken at both places. The analyses showed that the proportion of moisture in the coal used was practically the same both at Berlin and Munich.

In order to follow the course of carbonization in each case, the retorts or chambers were charged as quickly as possible one after the other. The charge was worked off in the vertical retorts in eleven hours, or, in the later trials, twelve hours. The Munich charges were intended to be drawn at the end of twenty-four hours; but owing to the difficulty of handling the large quantity of coke discharged at one time, in the absence of suitable conveying plant, the discharging of the six chambers had actually to be spread over two hours. The yield of gas, however, was taken for the twenty-four hours only. It was found that the workmen were less incommoded by smoke in charging the carbonizing chambers than when charging the vertical retorts. The ascension pipes of the latter, before each charging, had to be cleared with the auger of a deposit of thick viscous tar, otherwise troublesome stoppages occurred. This work, owing to the viscosity of the deposit, was frequently troublesome and tedious. Thus the vertical retorts did not exhibit the freedom from stopped ascension pipes which had earlier been claimed for them. Evidently the descriptions of coal carbonized affect the frequency of such occurences. Obstructions, indeed, occurred also with the carbonizing chambers at Munich; but they were more quickly got rid of by special means without interrupting the working. During the trials, however, these means were discarded and the auger used in the ordinary way. It cannot be definitely asserted that one plant has any advantage over the other in regard to the frequency of stoppages. The formation of thick tar in the hydraulic main, which had been said earlier to be absent with the vertical retorts, in these trials proved to be as common with them as with the carbonizing chambers; and it had to be removed in both cases by mechanical means.

The vertical retorts showed considerably greater difference in temperature in the different parts than the carbonizing chambers. The temperatures given in the table [see "Journal," June 30, p. 929] for the vertical retorts referred to the lower part of them; but those for the carbonizing chambers are the mean of measurements made at both the back and front of the chambers. The vertical retorts are very hot at the base—indeed, as hot as possible, but are considerably cooler above. The carbonizing chambers, on the other hand, are almost uniformly heated over their whole length. It does not appear that there is any justification for the view that these chambers cannot be adequately and uniformly heated. Scurf is found in both; but that formed in the carbonizing chambers is much more easily removed than that in the vertical retorts. Herr Prenger has already reported that the scurfing of the vertical retorts occupies about eleven hours, whereas from 30 to 40 minutes suffices for the carbonizing chambers, and the work is less arduous.

The yield of gas naturally depends on the temperature. In the Munich trials with the mixture of Königin Louise and Ravensworth coals, the temperature of the chambers was gradually increased in the course of the trials; so that ultimately the yield of gas per ton was raised to 13,263 cubic feet at 60° Fahr. and 30 in. The yield of 12,096 cubic feet of gas per ton already given for the Munich chambers therefore represents a fair normal working result, and it is not due to the chambers having been continuously worked at an extremely high temperature. The other mixtures of coals were carbonized throughout at ordinary heats, and ordinary heats were maintained in all the trials with the vertical retorts. It is important to recognize that, for comparative purposes, the productive capacity of a carbonizer should in the first instance be that obtained from the coal alone, and any additional yield, due to the admission of steam and the production of water gas in the retorts, should be excluded. This is apart from any views which may be held as to the desirability of making water gas at all in the retorts. It will be observed from the table given in the "Journal" for June 30, p. 929, that the yield of gas from all the three mixtures of coal tried was higher with the carbonizing chambers than with the vertical retorts. It may be worth while to recapitulate the average figures obtained.

Cubic Feet of Gas at 60° Fahr. and 30 in. Bar.

Type of Carbonizer.	Vertical Retort.	Carbonizing Chamber.
Half Königin Louise and half Ravensworth .	11,816	12,096
Half Königin Louise and half Silkstone . .	11,630	12,261
Half Königin Louise and half Lambton . .	11,605	12,057
Saar coal	—	12,642

A trial was made of Saar coal in the carbonizing chambers, at the desire of the authorities of the Munich Gas Works, because that coal is used for choice there. The trials made recently at Mariendorf by the Experimental and Instructional Works of the German Association are not very favourable to the vertical retorts, as they show a yield of only 11,397 cubic feet of gas at 60° Fahr. and 30 in. per ton of Silesian coal when it is gasified without the admission of steam. This yield is low, especially when it is considered that the coke obtained amounted to only 64·04 per cent. of the weight of coal, which indicates that the coal was rich in gas. The value obtained at Zurich (under the same auspices), of 12,129 cubic feet per ton of Saar coal, is low in comparison with the figure obtained at Munich of 12,642 cubic feet per ton. The low yield of gas from the vertical retorts is not altogether surprising, as the yield depends on the heat of carbonization; and these retorts are highly heated only at the lower part. More prolonged carbonization does not compensate for the want of sufficiently high heats; and, consequently, while the lower part of the coal gives a good yield of gas, the upper part does not. In the Munich chambers, on the other hand, the coal is uniformly carbonized.

The introduction of steam into the vertical retorts leads to an increase in the make of gas, owing to the production of water gas; but at the same time the calorific power is reduced. According to Herr Prenger, of Cologne, the yield is thereby increased by as much as 10·3 per cent., or, in one case, even by 11·2 per cent. Such a proportion of water gas, however, is not sufficient for town gas-works at the present time. In Berlin and in many other towns, special water-gas apparatus would be used to supplement the production of water gas in the retorts. Would it not be simpler and more advantageous under these circumstances to produce the water gas entirely in one apparatus, instead of having it spread over a large number of retorts? The special water-gas plant has the advantage that it can be more rapidly brought into use than fresh settings of vertical retorts. Moreover, the introduction of steam into the retorts softens the coke and renders it less suitable for storage than that produced without steam. Increase in the temperature of the carbonizing chambers admits of the make of gas being increased by 9·7 per cent. above the mean, or by nearly as much as the make is increased in the vertical retorts by the introduction of steam.

The evolution of gas follows much the same course in both the vertical retorts and the carbonizing chambers; the production is very similar at individual hours, but it is rather more uniform with the chambers. The calorific value only was regarded in judging the quality of the gas, as the extension of the use of incandescent burners has done away with the value of illuminating power testings. In the Berlin trials, as small gasholders and the necessary apparatus for photometric tests were ready to hand, tests of illuminating power were made; but in Munich the arrangements were not suitable, and, consequently, the calorific power only was determined by means of a registering calorimeter. A similar calorimeter was used in the Berlin tests; but intermittent testings were also made there with an ordinary calorimeter. The results were fairly concordant; and the figures given in the table on page 927 of the "Journal" for June 30 last are the means of the readings obtained in both ways.

It will be seen from the table that the calorific value of the gas from the vertical retorts is on the average higher than that from the carbonizing chambers, which corresponds with the relative makes of gas obtained. In a few trials in which the makes per ton were nearly the same for the two types of plant, the calorific value of the gas was also practically identical. The last trials of the carbonizing chambers with Saar coal indicate that a high

* See "Journal," Vol. CII., p. 848. † *Ibid.*, Vol. XCIX., pp. 438, 501.

make of gas could be obtained with these chambers, together with a high calorific value. The low proportion of sulphur in the gas from vertical retorts has been made much of. The table previously given shows that, in the case of one of the mixtures of coal, the sulphur was lower in the chamber gas, but higher for the other two mixtures. The higher proportion of sulphur corresponds with a higher yield of gas and the higher carbonizing temperature employed. With the same make per ton, the vertical retorts appear to yield gas containing the same proportion of sulphur as that produced in the carbonizing chambers. The yield of coke is on the average practically the same for the two types of carbonizers. The coke produced in the chambers has, however, a better appearance, and is larger and firmer than that from the vertical retorts. The liquor made is about the same in both cases; but it could not be ascertained with absolute certainty whether the amount of ammonia produced was similar. At the Munich works the gas passed through a Ledig washer which contained about 1320 gallons of water. This water was not entirely renewed on the different days of the trial, so that the liquor produced in one series of trials could not be kept apart from that for the next description of coal. The quantities of ammonia given in the table (*loc. cit.*) are therefore only approximate, but indicate that the yield of ammonia per ton of coal is virtually the same as with vertical retorts; and as the yield with the latter is greater than with horizontal and inclined retorts, it is similarly greater with the carbonizing chambers. The yield of tar is lower with the chambers than with the vertical retorts; but it should be remembered that, as the object of carbonization is primarily to make gas, and not tar, this is really no disadvantage. The carbonizing chambers yield more gas; and 80 cubic feet of gas at present prices is more valuable than 1 lb. even of the superior vertical retort tar.

Summarizing the points dealt with, it may be said that:—

(1) The carbonizing chambers yield more gas fit for use than the vertical retorts, apart from any addition due to the admission of steam (which has not yet been tried with carbonizing chambers).

(2) The yield of coke is the same with both, but the coke from the carbonizing chambers is better than that from the vertical retorts.

(3) The yield of liquor is the same with both, and both it and the yield of ammonia are higher with both vertical retorts and carbonizing chambers than with horizontal and inclined retorts.

(4) Deposits of thick tar and stoppages of ascension pipes occur with both.

(5) Scurf is formed in both; but it may be more easily and more quickly removed from the carbonizing chambers than from the vertical retorts.

(6) The carbonizing chambers are charged every twenty-four hours; the vertical retorts, every eleven hours. Consequently, the former require less labour than the latter. Also they incommode the workmen less through smoke.

In concluding his remarks, Professor Drehschmidt said that, while it appeared to him that at present the Munich chambers were more advantageous as carbonizers, he would be glad to learn if he had been led to an erroneous conclusion on this point.

Discussion on the Carbonizing Papers.

The "Journal für Gasbeleuchtung" gives a verbatim report of the discussion which took place at the Berlin meeting of the German Association on the papers read by Mr. E. Körting, on "The Latest Development of Gas-Making Settings" ("JOURNAL," Vol. CII., p. 940); by Herr Weiss, on "Experience in Working Vertical Retorts" (Vol. CII., p. 846); by Herr Ries, on "The Carbonizing Chambers at the Munich Gas-Works" (Vol. CII., p. 848); and the foregoing communication by Professor Drehschmidt. In view of the importance of some of the remarks, a more detailed summary will be useful to supplement the brief report given in the "JOURNAL" at the time of the meeting.

Professor H. Bunte, of Carlsruhe, opened the discussion. He said that reference had been repeatedly made to the work which had been done by the Experimental and Instructional Works of the Association in carrying out efficiency trials with vertical retorts at the Mariendorf works in Berlin, and at the Schlieren works in Zürich. Thanks are due to Messrs. Körting and Weiss and the Engineers and Chemists of the works in question for facilities given for the carrying out of these trials. The general methods employed, and the results, have been given in a leaflet. [This leaflet, which was handed round at the German meeting, gave the information which was communicated almost simultaneously to the meeting of the Institution of Gas Engineers in London in connection with the report of the Institution Committee on Carbonization—see "JOURNAL," Vol. CII., pp. 807 and 813]. It was endeavoured in the trials to test the vertical retort plant under normal working conditions, and without any special preparation. The figures obtained, taken in conjunction with Herr Weiss's paper, speak for themselves. It may be pointed out, however, in regard to what Professor Drehschmidt has said, that the normal working of vertical retorts at the present time comprises the introduction of steam. The admission of steam finds its justification in the fact that thereby gas of the quality which is required under modern conditions is forthwith produced. Gas-making plant nowadays should produce normal gas. It has been generally accepted that gas of not less than 5000 calories per cubic metre at 0° C. and 760 mm. (532 B.Th.U. per cubic foot at 60° Fahr. and 30 inches) is what is required under present conditions of gas supply; and it is disadvantageous to produce gas of considerably higher calorific power and high illuminating value.

The Mariendorf and Zürich Gas-Works, at which the trials referred to were carried out, base their manufacture of gas on this assumption, and, consequently, have adopted as normal working of the vertical retorts the production of water gas for a certain period after the carbonization of the coal is completed. Mr. Körting has rightly stated that uniformity of quality of the gas is of extreme importance. In the speaker's opinion this requirement can be fulfilled without difficulty with both types of carbonizers. Uniformity in the quality of the gas, indeed, requires greater attention at the hands of gas managers than it frequently receives. The freedom from the necessity of maintaining a certain illuminating power which the introduction of incandescent burners achieved, must not be used to sanction distribution of gas of widely varying quality. This remark applies in particular to the admixture of water gas. It would be better in small gas-works to seek other means of increasing the quantity of gas made than the use of water-gas plant, as violent fluctuations in the quality of the gas, which are apt to ensue when water gas is made, can only cause dissatisfaction with the supply. The Council of the Association have raised the question for consideration by one of their Committees, "What are the requirements of the present day in respect of the methods of gas manufacture and its relation to the quality and use of the gas?"

Returning to Mr. Körting's remarks on the appraisement of the utility of different types of settings, it would certainly be convenient if a relation could be established for the settings between the heating surface of the retorts or chambers and the quantity of coal carbonized. But it would be extremely difficult to establish such a relation, as only a relatively small part of the heat introduced into the settings is actually transferred to the coal, which is the material to be heated. A large proportion of the heat, which may be more or less recovered through regenerators, is lost, in the hot chimney gases; and a further large proportion is lost through radiation and conduction from the large surface of the walls of the settings—indeed, types of settings might be valued so far by the relation between the heating surface of the retort or carbonizing chamber and the walls of the setting. With the vertical retorts, this ratio would be very favourable, as the vertical walls from which heat is withdrawn through the ascending air have a relatively low temperature. Settings of horizontal retorts, on the other hand, suffer great losses of heat through the projecting iron mouthpieces of the retorts. It would seem useful to adopt porous, in place of solid, fire-bricks, on account of their lower conducting power, in many parts of the walls of retort settings; and it is not improbable that considerable economy in fuel might be achieved in this manner. Observations which have been made at the experimental works of the Association on the losses of heat through radiation and conduction have unfortunately not yet produced any useful result.

It should be observed that, owing to the very different behaviour of different varieties of coal when they are carbonized in vertical retorts, carbonizing chambers, or other types of retorts, the choice of coals for the new pattern carbonizers should be considerably extended. The gas-works should be placed in a position of being able to use the more recent and cheaper coals in place of the gas coals which have reached very high prices. Coals rich in oxygen yield gas of low illuminating power on account of the high proportion of carbonic acid in it; but if this gas is judged by its calorific value, instead of its illuminating power, this is of little moment. The coke made from such recent coals in horizontal retorts, is bad and brittle; but that produced in vertical retorts and carbonizing chambers from the same coal, is very much denser and harder. It is true, as Herr Weiss has pointed out, that these good qualities of the vertical retort coke carry with them many disadvantages. For instance, the sale of the coke by measure does not answer well on account of the small volume, and the coke is not very suitable for use in small household fires. Experiments should be made with a view to producing, from the more recent coals in the new types of carbonizers, without any reduction in the yield of gas, a coke which has the good qualities of gas coke.

In regard to bye-products, apart from coke, little was done in the efficiency trials at Mariendorf and Zürich. The important question of the production of naphthalene, sulphur, and ammonia can be more readily dealt with in trials on a smaller scale. It is well known that, in the trials of the vertical retorts at Dessau, an increased yield of ammonia, a smaller production of cyanogen, and a reduced quantity of sulphur in the purified gas, as well as a much smaller amount of naphthalene, were observed; but further observations are required on this point. The proportion of sulphur in the purified gas has hitherto been of small importance in Germany; but with the increasing use of gas for heating purposes, the sulphur question is now becoming more important, and should be kept in mind with a view to finding some suitable treatment. It is much to be desired that the vertical retorts or the carbonizing chambers will constitute an advance in this direction; and observations should be made as to what factors are of importance, and especially what is the influence of the introduction of steam on the proportion of sulphur in the gas. The cyanogen is not so important, as a larger yield of cyanogen will not by itself determine the choice of a type of setting. The greater production of ammonia, on the other hand, has more

significance. It may be traced to the larger carbonizing vessels, in which the coke, either through the introduction of steam or through the water evolved during carbonization, has a portion of its nitrogen converted into ammonia. The formation of naphthalene has not been investigated with the Munich chambers; but it is known to be smaller with the vertical retorts. The introduction of steam, however, resulting as it does in a dilution of the gas, may be partially responsible for the freedom from naphthalene deposits which has been observed. Dr. Bueb, by his use of steam in vertical retorts, which has overcome the naphthalene difficulty, has thus made superfluous his earlier invention of the extraction of naphthalene by washing.

When a mixture of water gas and coal gas is made, the question of the proportion of carbonic oxide assumes considerable importance. In the Mariendorf and Zürich trials, the proportions were about five volumes of coal gas to one volume of water gas. The proportion of carbonic oxide then was very little higher than in neat coal gas, and did not approach a figure which could give rise to uneasiness. It would, of course, be best if the carbonic oxide could be wholly eliminated from illuminating gas. Mr. Körting has touched on this point by referring to the artificial production of methane. Coal gas owes its high calorific value mainly to the methane it contains; and the admixture of water gas reduces it more or less. At high carbonizing temperatures methane is split up into carbon and hydrogen, and the volume is thereby doubled. But the net calorific value of a cubic foot of methane is nearly 970 B.Th.U.; whereas that of the hydrogen resulting from it is only 583 B.Th.U. Obviously at high enough temperatures, therefore, say 13,300 cubic feet of gas may thus be obtained from a ton of coal; but such a method of increasing the volume is not economical. Apart from the decrease in the calorific value of the gas, there is a greater expenditure of fuel in heating the settings. Hence it is more reasonable to increase the make of gas by injecting steam.

As to the relation between carbonic oxide and methane, MM. Sabatier and Senderens showed in 1902 that when a mixture of carbonic oxide and hydrogen was passed over pumice on which nickel had been deposited, heated to about 250° C., methane and water were formed according to the equation: $CO + 3H_2 = CH_4 + H_2O$. Thus one-third of the hydrogen was burnt by the oxygen of the carbonic oxide to water, and the remaining two-thirds combined with the carbon to form methane. The finely-divided nickel had merely a catalytic action. In both coal gas and water gas there are carbonic oxide and hydrogen; and by suitable means it should therefore be possible to get rid partially or wholly of the carbonic oxide, while increasing the proportion of methane in the gas. Thus a gas of high heating value and free from carbonic oxide should be obtainable. Trials made in the experimental works of the Association have shown, however, that this simple reaction cannot be directly applied to coal gas. But further investigations by Drs. Mayer and Henseling revealed the fact that solid carbon in various forms, such as coke, would, under suitable conditions, combine directly with hydrogen to form methane. This, however, has so far only been done on the laboratory scale, and clearly considerable changes would be necessary to do the same thing on a works. But it may be well, before assuming that this reaction would be impracticable as the basis of a works' process, to bear in mind that the rare earths which were almost unknown to chemists a few decades ago are now employed in a mixture which is used everywhere for lighting streets and houses. Having regard to this, it seems desirable that a certain amount of purely scientific research should be pursued in the laboratory of the Association's experimental works alongside the practical investigations. The union of science and practical work should contribute greatly to the advancement of the gas industry, as it has already benefited the sister electrical industry.

Further report of the discussion—so well started by Dr. Bunte in the remarks here translated—must be held over until our next issue.

TECHNOLOGY OF DESSAU VERTICAL RETORTS.

II.

By Thomas Holgate, M.Inst.C.E., F.C.S.

The tabulated statements given on p. 641 of the "Journal" last week may not only be considered as to the tests therein incorporated, but may be used to elucidate an important anomaly in the figures given by Herr Körting on p. 97 of the "Journal" for Jan. 14, and to which attention was drawn by Dr. Colman on p. 683 of the issue for March 17. But before analyzing in detail this anomaly, which relates to Mariendorf, a supplementary remark must be made *apropos* of the British report on the Dessau experiments. In lines 3 and 5 of Table II., it is shown that for gross and net heating power per ton of coal, steaming gave an increase of 160,844 and 135,163 B.Th.U. respectively. If to the make for the steaming and non-steaming periods given in the report be adjusted the figure calculated by the writer for the water gas produced, these figures become 212,348 and 181,421 respectively. Both these pairs of figures contain two assumptions; but if the calculation be made upon only one of the assumptions—and that is the inference of the quantity and quality of the water gas from the average analysis of the purified gases—then the figures become 174,048 and 156,063 respectively. In other words, 507 cubic feet of water gas, consisting of 180 cubic feet of carbon monoxide and 327 cubic feet of hydrogen, were produced by steaming; and these would yield 61,560 B.Th.U., both gross and net, and 112,488 gross and 94,503 net respectively. The last named computation is seen by the following table to be nearly equal to the average of the two preceding ones:—

Table III.—*Increase of Heating Power of Gas, due to Steaming, Dessau, May, 1908.*

Per Ton of Coal Carbonized.	A. As Calculated from the Report.	B. As A, but with Adjustment as to the Water Gas Made.	Average of A and B.	Of Water Gas Calculated only from the Analyses of the Purified Mixed and Unmixed Gases.
British thermal units, gross .	160,844	212,348	186,596	174,048
" " " net. .	135,163	181,421	158,292	156,063

Considering the magnitude of the figures to which these relate—the differences being only about one-fortieth of the totals—and to the difficulties that exist as to the data, it may perhaps be said that the various computations are not very divergent, and point to some degree of usefulness in the method employed.

On line 12 of Table I. (*ante* p. 641), it is shown that for the non-steaming operation the candles per ton of coal were 37,042 for Dessau and 36,252 for Mariendorf—a difference of 790 or 2 per cent. in favour of the former, and agreeing very nearly with Herr Körting's statement on p. 97 of the "Journal" for Jan. 14 last, that the working at the two places differed but a hair's-breadth. However, in Herr Körting's Table VI., he gives the illuminating power as 17·7 and 10·8 candles respectively—a disparity which Dr. Colman believed indicated a decomposition of hydrocarbons by excess of steam. The experiments in May appear to indicate that the anomaly has been largely reduced, and, indeed, make it scarcely necessary to call in the aid of the theory which Dr. Colman was careful to point out was put forward tentatively. Table IV. makes clear the relation between the steaming operation in the 5-metre retorts at Mariendorf and the non-steaming operation in the 4-metre retorts at Dessau, including both the January and May returns. For convenience of reference, line 7 is included, showing the figures of the non-steaming operation at Mariendorf in May.

Table IV.

Date of Return or Test.	Cubic Feet of Gas per Ton of Coal.	Gross Calorific Power per Cubic Foot.	Gross Calorific Power of Gas from One Ton of Coal.	Illuminating Power in No. 2 "Metropolitan" Burner per 5 Cubic Feet.	Illuminating Power per Ton of Coal.		Line Number.
		B.Th.U.		Candles	Candles		
January, 1908 .	13,478	546	7,358,988	10·80	29,112	Mariendorf	1
May, 1908 . . .	13,810	537	7,415,970	12·16	33,586	Retorts Steamed	2
Difference. . .	+ 332	− 9	+ 56,982	+ 1·36	+ 4,474		3
January, 1908 .	11,292	597	6,741,324	17·70	39,973	Dessau	4
May, 1908 . . .	11,259	604	6,800,436	16·45	37,042	Retorts Not Steamed	5
Difference. . .	− 33	+ 7	+ 59,112	− 1·25	− 2,931		6
May, 1908 . . .	11,400	585	6,669,000	15·90	36,252	Mariendorf Retorts not Steamed	7

The agreement in gross calorific power results in the two tests is striking. Each pair is concordant, and exhibits an improvement in the five months of nearly 60,000 B.Th.U. But the lighting results are a complete contrast to these. At Dessau, the illuminating power has gone down to 1·25 candles per 5 cubic feet, or 2931 per ton of coal; while at Mariendorf there has been a rise of 1·36 candles and 4474 candles respectively. There was recorded in January a disparity of 39,973 − 29,112 = 10,861 candles, which in the May tests had dwindled to a little less than one-third that figure—viz., to 3456. Further, the non-steaming results of May show a difference of 790 candles in favour of Dessau; thus leaving only 3456 − 790 = 2666 candles to be accounted for on the lines of Dr. Colman's inquiry, in place of the 10,861 candles.

There remains for consideration here whether any part of the 2666 candles is due to the decomposition of hydrocarbons by excess of steam, or can be understood in some other way.

It must be remembered that Dr. Colman had a difficult task in March last to compare the non-steaming operating at Dessau on 4-metre retorts with the steaming operation at Mariendorf on 5-metre retorts. There were several elements compounded in each separate case. First, the relation of the coal distillation at the two works, and of the two different lengths of retorts; second, the differences in the suitability for water-gas generation. Now some of the elements classed under the first group not known in January last are now available; for by comparing line 5 with line 7 of Table IV. it is seen that the non-steaming working is almost identical at the two places the slight advantage both in heating

and lighting power resting with Dessau. Dr. Colman, assuming perfect equality, reckoned that 13,478 (line 1 of Table IV.) − 11,292 (line 4 of Table IV.) = 2186 cubic feet were water gas made at Mariendorf yielding 7,358,988 (line 1 of Table IV.) − 6,741,324 (line 4 of Table IV.) = 617,664 (gross) B.Th.U. per ton of coal. But if we take into account, as we ought to do, the 131,436 B.Th.U. (line 5 − line 7 of Table IV.) which the coal distillation at Dessau is better than Mariendorf, then we have a total of 749,100 B.Th.U. to credit to water gas made in the 5-metre retort. Now water gas when freed from non-combustibles must have a gross calorific power of 342 B.Th.U. per cubic foot. Therefore 2186 × 342 = 747,612 is a calculation yielding striking agreement with the observations of the gas produced in May. These last-named are shown on lines 2 and 7 of Table II.; and by deducting the latter from the former, the increase of gross heating power is seen to be 746,970 B.Th.U., and that of the make per ton 2410 cubic feet.

A pause must here be made to consider whether the figure of 342 B.Th.U. for the gross calorific power of the water gas made is one the writer is justified in adopting. Dr. Colman assumed a figure of 300 B.Th.U.; but on p. 684 of the "JOURNAL" for March 17, he says that at West Bromwich the average calorific power is 320 B.Th.U. No doubt the last-mentioned, which is Mr. Copp's figure, refers to water gas containing a larger percentage of nitrogen and also of carbon dioxide than applies to the gas we are considering.

It is noteworthy how low is the nitrogen content of gas from the vertical retort; the Dessau analyses showing an average of 2·925 per cent. for the non-steaming, and 2·6 per cent. for the steaming periods. Moreover, the water gas has before analysis been washed with coal gas containing ammonia; so that at the end only a small percentage of carbon dioxide would remain. For pure water gas we can say its gross calorific power will be 342 B.Th.U. as to its carbon monoxide and 344 as to its hydrogen, and that in a commercial purified water gas the percentage by volume of the latter will be greater than the former. Such a gas then can only have a calorific power less than 342, to the extent determined by the nitrogen content thereof. As, however, for water gas made in the vertical retort no air is admitted, and as the tests above referred to show no accession from this cause, but rather the reverse, there appears no reason why any abatement should be made. The close agreement of the calculated and the actual values given above would appear to fully confirm the basis adopted, which may provisionally be used until further research shows the figure to be untenable.

Table V. shows the close agreement of the three methods of computation; their mean being 747,894.

TABLE V.—*Summary of the Values for Water Gas produced in Five-Metre Retorts at Mariendorf.*

Reference to Table IV., showing how the Calculation has been made.	B.Th.U. Gross Heating Power per Ton of Coal.
Line 1—line 4, of Table IV.	617,664
,, 5— ,, 7 ,, do.	131,436
Total	749,100
Line 1—line 4 = 2186 cubic feet × 342 B.Th.U. . .	747,612
,, 2— ,, 7 of Table IV.	746,970
Average of the three values for water gas	747,894

It would thus appear that we are justified in believing that at Mariendorf one-tenth of the heating power of the gas made is due to steaming—viz., $\frac{746,970}{7,415,970} = 10{\cdot}1$ per cent. This is perhaps the most definite statement that can be made; but included therein as one of the factors is the volume of gas per ton. As to this, it is worthy of note that the results on lines 5 and 7 of Table IV. show at Mariendorf a make of coal gas alone of 141 cubic feet more than at Dessau; and if this be added to the 2186 already attributed to water gas, we obtain a total of 2327, which is not far from the 2410 observed in May, and probably may be regarded as a confirmation of the latter.

The difference in illuminating power shown above, of 2666 candles, can now be more closely considered. This is equal to a diminution of $\frac{2666}{36,252} = 7{\cdot}4$ per cent. In a No. 2 "Metropolitan" argand burner, it is inconceivable how the 2410 cubic feet (equal to 21 per cent.) of water gas can add to the illuminating value of the 11,400 cubic feet of coal gas; but, on the contrary, on combustion it must, by reason of the extra air that must be admitted, produce a reduction in the concentration of the light-giving agents in the flame. Both added gas and air must leave the chimney at a considerably higher temperature than they enter, and possibly at a slightly higher temperature than the water gas alone generates.

In a study of gas testing by the writer, he has shown that the luminosity in an argand burner is largely dependent upon both the volume and the weight of the products of combustion from the chimney, when the maximum flame is reached. It is therefore quite likely that the addition of 21 per cent. of such gas as we have been considering—where hydrogen preponderates by volume and carbon monoxide by weight—will have such an effect upon luminosity as to account for the 7·4 per cent. diminution of candle power per ton of coal referred to.

The broad results of this consideration of the British and German reports is to show their concordance; and if the views herein expressed should prove to be correct, they will furnish internal evidence as to the great care exercised in the making of the tests for which all gas engineers must be grateful.

OBITUARY.

We regret to learn through the "Journal für Gasbeleuchtung" of the sudden death on the 25th ult. of Herr PAUL SEEMANN, the Manager of the Leipzig Municipal Gas-Works. Deceased was born in Berlin in 1854, and received his training as a Gas and Water Engineer there. In 1885, he went to Leipzig as inspector of the town gas distributing system; and on Jan. 1, 1907, he was promoted to the position of Manager of the gas-works. He was a zealous and efficient officer; but being of a retiring disposition, he was seldom seen at meeting of technical societies.

The death occurred last week of Mr. CHARLES A. WHITMORE, who for a period of twenty years represented Chelsea in Parliament, in the Conservative interest, but who was defeated in 1906. Born in 1851, he was called to the Bar in 1876, and for many years took an active part in political life in the Metropolis. He was an Alderman of the London County Council, and served as a member of the recent Royal Commission on the Police. Mr. Whitmore will be remembered by readers of the "JOURNAL," however, from his connection with Select Committees on various Gas Bills, his conduct as Chairman of which indicated his full appreciation of the matters dealt with.

PERSONAL.

Mr. HENRY G. RITCHIE, Assistant-Manager of the Kirkcaldy Gaslight Company, Limited, has been appointed Manager of the Fraserburgh Gaslight Company, in succession to Mr. Lang, whose appointment to Alexandria is noted below.

Mr. FRANCIS ROOK, who has been appointed Manager to the St. Margarets Gas Company (Herts.), has been with Messrs. S. Cutler and Sons for a number of years, superintending the erection of different kinds of plant at gas-works throughout the country.

On Monday of last week, Mr. ANDREW M. MACLEOD, the Station Manager of the Dawsholm Gas-Works of the Glasgow Corporation, was, to mark the occasion of his marriage, presented by the employees and friends with a silver tea service; the presentation being made by Mr. Robert Smith, the General Foreman. Mr. MacLeod has been connected with the works for a period of 23 years, during four of which he has occupied the position of Station Manager.

We understand that from the 18th inst., Signor Ing. BÖHM, who for some little time past has been Resident Engineer of the San Celso (Milan) Gas-Works of the Union des Gaz Company, will remove from the works, and that a former Assistant, Mr. BLOW, will—provisionally at least—take his place. Signor Böhm went to Milan about three or four years ago from Palermo, and has been engaged as an expert in one or two gas-works purchase inquiries—notably that at Venice. He was also the Italian representative on the International Committee on Photometry.

Mr. JOHN LANG, Gas Manager at Fraserburgh, who has just been unanimously appointed Manager of the Vale of Leven Gas Company, Limited, Alexandria, out of 120 applicants, is a native of Dumbarton. He holds first-class certificates in the ordinary and honours grades examinations in "Gas Manufacture" of the City and Guilds of London Institute. The first twelve years of his business career were spent in the service of the Dumbarton Gas Corporation, under the late Mr. James M'Gilchrist; and then for six years he acted in the capacity of Assistant Manager. During that time he had a wide experience in the preparation of plans for new gas-works and extensions in various parts of the country. Five years ago Mr. Lang received his present appointment as Manager and Secretary to the Fraserburgh Gas Company. Since that time the quantity of gas manufactured at Fraserburgh has increased nearly 50 per cent.; and the price has been reduced by 5d. per 1000 cubic feet for lighting, &c., and 10d. per 1000 cubic feet for motive power. Mr. Lang has, during his term of office at Fraserburgh, designed and executed several extensions, including the erection of a large holder on a new site, on which the Company intend at a later date to build complete new works.

Mr. EDWARD R. LOVEGROVE, J.P., the late Chairman of the Maidenhead Gas Company, left estate entered for probate at £11,296.

It is announced that Mr. W. EWING, who has been for eight years Engineer and Manager of the Gas Department of the Greenock Corporation, on Wednesday last sent in his resignation, on account of differences of opinion which have arisen between him and the Corporation.

WAGES AND HOURS OF LABOUR IN 1907.

In view of the great slackness of trade from which the manufacturing industries of the country generally are now suffering, the figures relating to wages and hours of labour in 1907 cannot be taken as having any close bearing on the state of affairs which exists at the present time. They need not, however, be shortly dismissed on this account; and some particulars may be taken from the fifteenth report on the subject of Mr. A. Wilson Fox, of the Labour Department of the Board of Trade, which, as usual, contains much interesting information. The year referred to was a satisfactory one from the workers' point of view, inasmuch as the upward movement of wages which began in the second half of 1905 and continued in 1906, was maintained during 1907; and at the end of the year wages stood at a higher level than at the end of any year since the statistics were first recorded, which was in 1893. The total number of workpeople whose rates of wages were changed also exceeded that of any previous year; but it is pointed out that the net increase was due to a very large extent to advances in the coal mining industry, though there were also important advances in the textile, pig iron, and iron and steel trades. Every group of trades, however, benefited in some degree; and the net result of all the changes was an increase of £201,000 per week. In the first six months of the present year there has been a net decrease of £16,247 per week; the predominant factor being adverse changes affecting coal miners. The total number of people whose rates of wages were changed in these six months was 851,119; and this number was nearly equally divided between rises and falls, though the decreases, as already stated, in the aggregate amounted to a good deal more than the increases.

Coming back to the year 1907, it is stated that, so far as the department were able to ascertain, over 1,246,000 workpeople had their rates of wages changed. Of these, about 1,243,000 received advances amounting to £201,200 per week; while the other 3000 sustained decreases aggregating £200 per week. This left the net increase at £201,000 per week, which compares with an advance of £57,900 a week in 1906. Calculating the effect of the changes in 1907 from the date at which they took place to the end of the year, the aggregate increase in wages due to them is computed at £5,821,000, as against an increase of £1,419,000 in 1906, and decreases of £114,000 in 1905, £938,000 in 1904, £500,000 in 1903, £2,300,000 in 1902, and £1,600,000 in 1901. In fact, the changes for the five years 1896 to 1900 showed increases, the next five years decreases, and the last two years increases again. It is, however, almost too much to hope that, with the prevailing depression, another cycle of five years of continuous increases, starting with 1906, will be experienced. Wages in the coal-mining industry have been high; but only quite recently Lord James of Hereford found that a reduction was justified. Then, again, in the cotton trade the wages question has become a sore one; and it is now no longer a matter of whether a reduction is necessary, but merely as to how long the operatives can stave it off. In other directions, too, the same tendency is manifesting itself, or is likely soon to do so. As a set-off, however, against this outlook, it should be pointed out to the workers that the changes in the twelve years 1896 to 1907 have resulted in a net rise of wages in each group of trades (except quarrying) to a total extent of £467,500 a week, of which coal-mining accounts for no less than £266,000.

The proportion of people affected by changes in wages in 1907 was again largest in the coal-mining industry—93 per cent. In every coalfield the miners enjoyed net increases—ranging from 15 per cent. to 43¾ per cent. The total number of miners for whom changes in wages were reported was 806,339; and the net amount of increase in their weekly wages was estimated at £173,613. During the past ten years both ups and downs have been experienced in the coal-mining industry; but the aggregate amount of the increases has been considerably in excess of that of the decreases. Taking all the districts, the net effect of the changes in wages which occurred in 1907 was net advances of 23¾ per cent. on the standard in Northumberland, 21¼ per cent. in Durham, 17½ per cent. in Cumberland, 15 per cent. in the Federated Districts, South Staffordshire, East Worcestershire, Bristol, the Forest of Dean, and Somerset, 22½ per cent. in South Wales and Monmouthshire, and 43¾ per cent. in Scotland.

In the textile trades the proportion of people employed who were affected by changes in wages last year was 20·8 per cent.; the alterations being invariably in the upward direction. Similarly, in iron-mining and quarrying such changes as there were took the form of advances; and in the metal, engineering, and shipbuilding trades an increase of £9124 per week was recorded. It is, however, remarked that in 1907 employment in the engineering trades was not on the whole so good as in 1906; it showed a marked decline towards the end of the year. The mean percentage (3·8) of Trade Unionists unemployed was somewhat higher than in the previous year. Employees of public authorities on this occasion, as has been the case in each of the preceding nine years, exhibit an increase—8640 workpeople having received a net increase of £596 per week. Among these are included employees of some of the municipal gas-works. At Darlington, lamplighters' wages were increased 1s. 6d. per week to 25s. 6d., and the foreman lamplighter's 2s. 6d. per week, to 30s. 6d. The same body of men at North Shields received 1s. more; the wages then being 21s., 22s., and 24s. a week. The Workington leading stokers and other stokers had an advance of 3d. per shift, making the weekly wages 43s. 1½d. and 39s. 4½d. respectively. At Bradford, the machine stokers, firemen, and enginemen were given a rise of 1s. 3d. per week, to 40s.; and the meter inspectors increases of 1s., 2s., and 3s., making the wages 28s. to 35s. a week. The labourers in the Leeds Gas-Meter Department had an increase of 1s. to 25s. a week. At Littleborough the lamplighters were given 1s. more, making their pay 18s. per week. At Manchester, the labourers, carters, blacksmiths, and strikers received advances of 1s., 3s., and 5s. per week; making the wages of the labourers 25s., 26s., and 28s., of the carters 26s., of the blacksmiths 27s., and of the strikers 27s. The lamplighters at Arbroath had an increase of 1s. per week, to 20s., 21s., and 22s. As to men in the employ of gas companies, the report does not contain any record of increases in wages having taken place within the period under review.

With reference to the methods by which changes in wages were arranged last year, 4·6 per cent. were under sliding-scales, against 5·2 per cent. in 1906; 58·8 per cent. were by conciliation boards, mediation, arbitration, &c., against 37·1 per cent.; and 36·6 per cent. were by other methods (direct arrangement, negotiation, &c.), against 57·7 per cent. The increase under the heading of conciliation boards, &c., was mainly due to the fact that coal miners in the Federated Districts (Lancashire, Yorkshire, Midlands, North Wales, &c.) had changes in wages in 1907, whereas no general changes in wages in these districts took place in 1906. As in previous years, the number of workpeople whose changes in wages were preceded by a stoppage of work fortunately formed only a small fraction (1 per cent.) of the whole. In fact, the percentage of persons so affected was less than in any of the preceding years 1898 to 1906. It has to be noted, however, that in the 1 per cent. stated no account is taken of strikes for increased wages that failed, or of threatened strikes or lock-outs that may have influenced the changes in wages made.

The changes in hours of labour recorded (which do not include temporary alterations in the working hours owing to changes in the state of trade) affected 36,200 workpeople, of whom 35,400 had their hours of labour reduced. The net effect of all the changes was a reduction of 79,000 hours in the weekly working time of the persons affected. In every year since 1898 there has been a large net reduction in the hours per week of the persons affected by such changes.

TRADES UNION CONGRESS.

Meeting at Nottingham.

In many respects bearing a striking resemblance to the annual gatherings that had gone before, this year's Trades Union Congress, which took place last week at Nottingham, has yet secured a considerable amount of attention—perhaps a little more than may reasonably be considered as due to it, when judged by what is likely to be the total practical outcome of the business transacted. There were 518 delegates, representing 213 societies, with a membership of 1,776,000—the number of Unionists represented at last year's gathering having been 1,693,000. This is progress, if no more than slight. But the congress, even from the Trades Union point of view, was not thoroughly representative, inasmuch as the Amalgamated Society of Engineers, with its 100,000 or so members, was again absent from the deliberations.

After having been welcomed on Tuesday morning by the Mayor, and addressed by the three Members of Parliament for the city and other speakers, the delegates settled down to hear the Presidential Address of Mr. D. J. Shackleton, M.P., which dealt with many topics in which his listeners were more or less interested. Beginning with old-age pensions, he expressed the opinion that seventy years was an outside age limit, in these days of pressure of work and speeding of machinery. Sixty years he thinks is an adequate limit for those who run the many risks which attend occupations in factories and workshops, mines, buildings, ships, and the various agricultural occupations of the country. On the question of unemployment, Mr. Shackleton's figures speak eloquently as to the state of trade. In July, in 268 Unions, with a net membership of 646,511, as many as 53,163, or 8·2 per cent., were reported as being unemployed, compared with 3·7 per cent. for the same month last year; and, as he pointed out, these figures only refer to skilled and organized trades, the members of which are likely to be in a better position than the unskilled and the unorganized workers. The remedy that he suggests for this unfortunate state of affairs is not a new one—in fact, it was, to quote one instance, advanced by his immediate predecessor in office, Mr. A. H. Gill, M.P. It is reduction of the hours of labour of those who are in employment and the stopping of all systematic overtime, not only here but in other countries, by an international movement. The concluding sentences of Mr. Shackleton's address indicate that the international policy of the Trades Unions is not quite the same as has on all occasions (judging by events) been considered the most advisable to pursue in the conduct of industrial affairs pertaining to our own country. They are as follows: "The cause of international peace and the settlement of international differences by the common-sense method of arbitration, rather than by the cruel method of war, is gaining ground among our people. Through the movements represented by International Co-operative Societies, and International Trades Union Congresses, and the International Socialist Congresses, a firm and immovable barrier is being built

against war being considered the only settlement of our difficulties. Working men and women in all countries have much in common; the same difficulties of unemployment beset them as beset us. 'Riches *v.* Poverty,' with all its consequent social problems, is ever with them, as it is here. They, like us, are beginning to see that war means delay and defeat of all that tends to raise them in comfort and influence in the State to which they belong. This Congress has always stood for international peace; and, in the words of the late John Bright, we call for the settlement of our international differences by a process which shall bring greater happiness and contentment of peoples, and shall promote and advance all that is good in the world, infinitely beyond anything that can ever be hoped for from the most glorious and bloody conflicts of armed men."

The proceedings on Wednesday opened with the consideration of the Parliamentary Committee's report, which, however, did not contain much of general interest. One matter that was referred to in it was the long anticipated Labour daily newspaper. The smallest amount of capital on which it is considered that it would be desirable to start this organ is £150,000; and of this between £20,000 and £30,000 has already been promised privately by members of affiliated societies. This leaves a large, but not, the Committee think, an impossible, sum still to be provided; and a contribution of 2s. per member is hinted at as a solution. "Seeing," it is remarked, "the vast importance of a daily newspaper to the Labour movement, in view of the impossibility it finds in getting its views placed before the public without bias, and securing a proper backing in the Press during times of trade disputes, this ought not to be regarded as an unreasonable burden." The proposal is that the paper shall be a halfpenny eight-page morning publication, to be called the "Morning Herald." Later on the Trades Union status of the Municipal Employees' Association was considered; a complaint being lodged against this very comprehensive organization that it was "poaching on the preserves" of other societies—which seems to show that there is a superabundance of bodies whose stated aim is the protection of the worker. At the finish a decision of the 1906 Congress was re-adopted—that "any method of organization which seeks to divide the workmen employed by public authorities from their fellows in the same occupations employed by private firms is detrimental to the best interests of Trades Unionism." A resolution binding the Congress to do everything in its power to restrict Sunday labour within the narrowest possible limits was unanimously agreed to, as was also one in the following terms: "This Congress, in view of the fact that the industrial classes constitute a majority of the nation, calls upon the Parliamentary Committee to formulate a Bill enacting the formation of a Department of Labour, with a responsible Minister invested with Cabinet rank, with authority to deal with matters affecting the industrial necessities of the workers, conditions of employment, wages, protection of life and health, efficient inspection of workshops and factories, and general labour conditions."

When they met on Thursday, the delegates by resolution declared that the Government must make provision for finding work for all sections of unemployed men and women. But before this was done, Mr. Will Thorne, M.P., managed to get in a remark worthy of note. "Eventually," he said, "the workers will have to tackle the question of machinery—not to destroy it, but to capture it, and have it worked and controlled for the benefit of the whole community." To Councillor J. Gribble, of Northampton, it appears that the best way of attaining their object is "to strike fear into the hearts of their legislators;" but beyond applauding the recent disgraceful scenes in Glasgow, he did not point out any definite way in which this fear was to be aroused. A second resolution on the same subject was carried, to the effect that the Government should consider the propriety of making grants in aid to trade organizations which during periods of slackness support their members by payment of out-of-work benefit. The next resolution, which was brought forward by Mr. J. Sexton, was in these terms: "That we strongly protest against the action of employers who are discharging and refusing to employ workmen over forty years of age, or those having some slight physical defect, but who are otherwise capable of doing a good day's work, owing to the embargo placed upon them by Insurance Companies, thereby depriving the men of the means of living. We therefore request the Congress to instruct the Parliamentary Committee to promote legislation to prevent this by a system of compulsory State insurance, and in the meantime to press the Government to institute an inquiry into the matter." A letter was read from the Home Secretary expressing his intention to proceed as far as possible during the autumn session with the appointment of a Royal Commission to inquire into the whole question; and this met with the approval of the meeting. A resolution condemning the House of Lords was carried; but the discussion on it produced a very candid statement of opinion from Mr. F. W. Welsh, of the London Bookbinders Union, who urged that "the House of Lords was a perfect Godsend to a Liberal Government, as it enabled them to bring forward measures which they had no intention of passing, because they knew the Lords would throw them out." The day's sitting concluded with an instruction to the Parliamentary Committee to assist the miners to get the Eight-Hour Bill passed. A request that the Committee should take what steps they could towards the passing of a law strengthening the provisions of the Conciliation Act of 1896 by conferring compulsory powers on the Board of Trade to inquire into any industrial dispute when requested by either party, was defeated—a fate which also befell a motion by Mr. Ben Tillett in favour of compulsory arbitration, which he picturesquely remarked would not take away the right to strike, or "to use their miserable pop-gun against the 12-inch gun of the capitalists."

On the remaining two days many matters were considered. Several resolutions relating to educational questions were discussed; and then the premium bonus system was condemned as one of the most objectionable forms of slavery ever introduced into factories and shops. A motion in favour of a legal eight hours per day or forty-eight hours per week was adopted; and subsequently it was agreed that "the Pensions Act will not be satisfactory until amended so as to provide for a minimum pension of 5s. per week without conditions to men and women of sixty years of age, and in the case of persons who by reason of their affliction of blindness are rendered incapable of earning their living the age limit to be entirely removed."

Next year's gathering will take place at Ipswich, when no doubt many of the questions discussed last week will once more come up for consideration.

GAS-ENGINE FAILURES.

We have again before us the annual report of Mr. Michael Longridge, M.A., M.Inst.C.E., the Chief Engineer of the British Engine, Boiler, and Electrical Insurance Company, Limited. There is never any lack of material for this report, which is not surprising when the great operations of the Company are considered, and the immense value of the steam, gas, oil, and electrical plants that are under their care as insurers and survey for their own protection. The first point that strikes one in the report is that gas and oil engines stand well among the power competitors for reliability. Among the steam-engines for which the Company are responsible, the rate of breakdown in 1907 was 1 in 11·7, among gas and oil engines 1 in 11·1, and among electric motors 1 in 7·9. This is for the gas industry an exceedingly satisfactory testimony from the point of view of relative mechanical reliability.

There is interest in the tables that give the proportions in which the various parts of the insured engines that broke down caused or initiated the breakdowns. The compilation for steam-engines, we pass over, and only reproduce those for gas and oil engines and electric motors.

Gas and Oil Engines.

Description of Parts which are Believed to have Given Way First.	Average Previous to 1906.	During	
		1906.	1907.
	Per Cent.	Per Cent.	Per Cent.
Valves and valve gear	32·5	28·7	43·3
Cylinders and cylinder ends	16·6	16·7	13·5
Pistons	11·7	6·5	2·7
Connecting-rods and their bolts	11·2	12·0	8·1
Main shafts	5·0	15·7	4·7
Governors and governor gear	4·4	7·4	7·4
Silencing-boxes and exhaust-pipes	4·4	2·8	1·4
Fly-wheels and driving-drums	4·3	4·6	4·7
Clutches and couplings	3·5	0·0	0·0
Frames and pedestals	2·8	0·0	4·0
Bolts*	2·6	0·9	1·4
Total wrecks, cause not ascertained	1·0	1·9	0·0
Main driving-ropes or belts	0·0	1·9	0·0
Miscellaneous	0·0	0·0	5·4
Gas producer plants	0·0	0·9	3·4
	100·0	100·0	100·0

* These do not include bolts in pistons, connecting-rods, valve-gear, and other moving parts; the bolts in these parts being included with the parts themselves.

The causes of these breakdowns may be roughly classified as under:—

	Gas-Engines. Per Cent.
Accident or causes unascertained	44
Old defects or deterioration by wear and tear	17
Weakness, bad design, workmanship, or material	18
Negligence of owners or attendants	21
	100

The first table suggests a few remarks. The increase in the breakages of valves and valve gears is not satisfactory, and demands the serious attention of makers of gas and oil engines. If all side shafts were fitted with ring lubricators and levers made of wrought iron or good cast steel, the percentage in the table would be reduced. The reduction in broken cylinders and pistons is encouraging, and marks the progress which is being made. Connecting-rods proved less destructive than usual, probably because of improvement in design, particularly as regards strength of bolts. The breakages of crank-shafts, too, were notably fewer than in 1906.

Examples of the breakdowns of gas-engines convey their own lessons. There is one illustration in which five horizontal gas-engines were concerned, supplied with town gas. These engines had cylinders varying from 7¾ inches diameter by 14-inch stroke to 7½ inches diameter by 13-inch stroke, running at about 200 revolutions per minute. All five were situated in one works. One evening in January, the driver was called away as he was stopping the engines; and, in hurrying to obey the summons,

Electric Motors.

Description of Part which is Believed to have Failed First.		Motors. 1906.	1907.
Armatures and rotors	per cent.	44	38
Magnet coils and stators	,,	14	14
Commutators and brush gear	,,	28	30
Miscellaneous	,,	14	18
		100	100

Starting Switches and Controllers.		1906.	1907.
Resistance coils	per cent.	48	60
Contacts and switch arms	,,	10	8
Automatic apparatus	,,	17	13
Miscellaneous	,,	25	19
		100	100

The causes of these breakdowns were probably as follows:—

		Motors.		Starters.	
		1906.	1907.	1906.	1907.
Accidental	per cent.	9	4	22	9
Dirt and neglect	,,	19	28	11	16
Age and deterioration	,,	25	23	23	27
Bad work or design	,,	18	18	9	8
Overloading	,,	2	1	7	5
Unascertained	,,	27	26	28	35
		100	100	100	100

forgot, or to save time neglected, to open the jacket drains. On returning the following morning, he found four of the five cylinder jackets cracked from end to end and full of ice. Mishaps of this kind occur every winter, generally during the Christmas or New Year holidays or on Sundays, even among insured engines, whose owners are warned both when the insurance is effected and on the approach of cold weather every year. The advice given is to fix a stop-cock on both the supply and return water-pipes close to the cooling-tank, and a drain-cock at the lowest point of the return pipe; so that not only the jacket but the pipes leading to and from it may be emptied. To empty the jacket only is not sufficient; for if the pipes between it and the cooling tanks be frozen, the water supply will be cut off, and the cylinder damaged or cracked by excessive temperature. When owners refuse to fit drains and stop-cocks, gas-jets under the cylinder are advised; but these do not always prevent freezing. In one case last winter, the jacket of a cylinder $5\frac{3}{4}$ inches diameter by 12-inch stroke was found one morning cracked by frost, although a gas-jet was burning under it, and so close to it as to cover the surface with soot. The heat from the jet had been insufficient to keep the water in the jacket liquid.

An unusual incident is brought before us in the case of a horizontal gas-engine, eleven years old, with cylinder 8 inches in diameter by 15-inch stroke, running at 150 revolutions per minute. Town gas was used. The connecting-rod was of forged steel, tapering from $1\frac{5}{8}$ inch to $1\frac{3}{8}$ inch diameter. The big end was of the marine type with two $\frac{3}{4}$-inch bolts. The eye at the small end, instead of being solid, was divided vertically; the half furthest from the crank forming a cap, which was secured by two $\frac{1}{2}$-inch bolts. One of these bolts broke at the bottom of the thread while the engine was running at the ordinary speed. Breakage of the other followed; and the rod, liberated from the piston, smashed the latter, knocked a hole through the bed-plate, and was itself snapped close to the palm at the big end, and close to the eye at the little end. The crank-pin brasses were also damaged, and the big-end bolts bent. The unusual incident to which the breakdown owes its mention was the fracture of the rod in two places. The breaks were quite clean, without any signs of bending or stretching—just as if the rod had been made of very brittle cast iron. The inertia stress upon the two $\frac{1}{2}$-inch bolts was about 740 lbs., or about 3070 lbs. per square inch of sectional area at the bottom of the threads.

Interesting is the experience recounted regarding a horizontal gas-engine, three years old, with cylinder 10 inches diameter by 21-inch stroke, with a speed of 234 revolutions per minute. The engine was fired with town gas, and drove a four-pole dynamo by a belt. The big end of the connecting-rod was of the marine type, with two bolts $\frac{7}{8}$-inch diameter, and nuts secured by a locking-plate. About half an hour after starting for an afternoon run, the nut seems to have come off the top bolt, for it was not found after the breakdown. The other bolt was stretched and broken; the brasses were also broken, and scattered about the engine-room. The connecting-rod was bent, and a piece broken out of the front end of the piston. The driver was absent when the breakdown occurred; but he declared positively that there had been no knocking either during the morning or when he started the engine after dinner. The story seems to be almost incredible. How did the nut get free from the locking plate? How did it screw itself entirely off the bolt? How did the remaining bolt hold the cap on while the delinquent nut was screwing itself off? The only other alternatives are that the nut burst spontaneously, and flew off, or that the man had taken the nut off, and started the engine without replacing it. The reader must choose for himself which tale he will believe. Mr. Longridge's comment is that his own experience of breakdowns leads to the conclusion that the scoffer at miracles must be a very superficial observer of ascertained facts. The stress upon the two bolts from the inertia of the piston and connecting-rod was about 6000 lbs., or about 7000 lbs. per square inch of sectional area at the bottom of the threads, to which would be added the stress due to the friction of the piston. It is wonderful that the bolts lasted three years under such heavy stresses.

Another chosen illustration is a horizontal gas-engine, fifteen months old, working with Dowson gas; cylinder $15\frac{1}{4}$ inches diameter by 23-inch stroke; with a speed of 184 revolutions per minute. The big end of the connecting-rod was of the marine type, with two bolts, $9\frac{1}{4}$ inches long, between the head and the screw, and $2\frac{1}{4}$ inches long in the screw—total length $11\frac{1}{2}$ inches. The bolts were $1\frac{1}{2}$ inches diameter, except for a length of $1\frac{7}{8}$ inches in the middle of the shank, where the diameter was reduced to $1\frac{5}{32}$ inches. The threads were Whitworth standard seven per inch. One morning, the upper of the two bolts broke through the thread next to the shank; and the lower bolt was stretched till its diameter was reduced to $1\frac{3}{32}$ inches, and then it broke at the reduced section. The piston was forced back into the clearance, and cracked circumferentially half way round the groove for the ring next the end. The cylinder end, liner, and jacket were all broken, and the connecting-rod and valve spindles bent. The stress upon the bolts due to the inertia of the moving parts was about 9000 lbs., or about 5030 lbs. per square inch of sectional area at the bottom of the screw-thread, assuming the stress to be equally distributed upon the two bolts. Besides the normal stress due to inertia, the bolts had been subjected to abnormal stress soon after the engine was first set to work, by the piston seizing and splitting the back end of the liner. The engine had worked for 405 hours in 1905, 2214 hours in 1906, and 378 hours in 1907—in all, 2997 hours, during which time it had made about 33,100,000 revolutions.

The case is quoted of a horizontal gas-engine, four years old, working with gas from a town main. The cylinder was 18 inches diameter by 20-inch stroke; and the speed 162 revolutions per minute. The little end of the connecting-rod was forged with a flat palm, to which the two brasses and cap were secured by two bolts $1\frac{1}{2}$ inches in diameter, screwed with six threads per inch. Shortly after starting the engine one morning, one of the bolts in the little end of the connecting-rod broke through the screw thread, the outside brass and cap were torn off, the palm at the end of the rod was bent, and the other bolt broken. The cylinder liner was broken, the piston cracked, and the connecting-rod bent, besides minor damage. The stress on the bolts, due to the inertia of the piston, would be about 5570 lbs., or 2220 lbs. per square inch of sectional area through the bottoms of the threads. The stress due to the friction of the piston is unknown. The engine had made about $103\frac{1}{2}$ million revolutions. The bolts were said to have been made of vanadium steel.

An accident with a horizontal gas-engine driven by suction gas is noticed. The engine was seven months old, with cylinder 20 inches diameter by 30-inch stroke, running at 160 revolutions per minute. Being unable to start the engine after the dinner hour one day, and observing water running down the exhaust-valve spindle, the attendant concluded that the joint between the liner and its water-jacket was leaking. He therefore took off the covers to examine the compression chamber, and found about a gallon of water in it, and a crack about 7 inches long in the side of the chamber near the sparking-plug. A new cylinder end was ordered from the makers' stock; and an inspector was sent to examine it before it was sent off. He found several of the ribs connecting the outer to the inner walls of the jacket cracked, although the casting had never been in use. The cracks were not long enough to render the end unserviceable; but the uncertainty as to the rate at which they might extend, and the direction the extensions might take, compelled the inspector to condemn the casting. As there was not another in stock, the engine had to be kept idle for three weeks, while a new cylinder end was moulded, cast, and finished. The cause of the first fracture is uncertain, though as the jacket was clean it was probably a stress produced by unequal expansion of the different parts of the casting. The cause of the second was no doubt contraction of the inner wall of the jacket after the outer had become set. If the core of the compression chamber had been removed, and the casting cooled from the inside, the ribs probably would have remained sound. The problem of designing an end which will not crack under the high temperatures and pressures obtaining in the cylinders of internal-combustion engines has not yet been solved, though very marked progress has been made.

(To be concluded.)

Italian Gas Society's Annual Conference.

Yesterday and to-day, the 14th and 15th inst., the members of the Italian Gas Society are holding their thirty-seventh annual conference at Lecco, under the presidency of Signor Luigi Valsecchi. Two visits are to be paid—one to the gas and electrica station of the Società "Orobia" in Lecco, which serves a number of communes in the district; the other to the works of Messrs. Antonio Badoni and Co., who are mechanical engineers and gas-works' contractors. Apart from the ordinary business routine of the conference, there are five subjects on the programme for discussion. They are: The lighting up and putting out of public lamps; a new type of governor; pressure-reducing valves; new systems of inverted burners; and gasholder tanks in reinforced concrete. No doubt a successful meeting will result; and the proposed trip on Lake Como to-morrow (Wednesday) will certainly be attractive, and a pleasant conclusion to the labours of our Italian gas colleagues.

THE EIGHT-HOURS BILL AND AFTER.

[COMMUNICATED.]

IT is assuredly a matter for congratulation that the Coal Mines (Eight Hours) Bill cannot, in any case, come into force for five years; and it is even now quite uncertain whether the Bill will ever be passed. It is, indeed, difficult to conceive why it was ever introduced; for all coal users, large and small (and to their numbers should be added gas consumers), are opposed to it. Where, then, are those in favour of it? The answer is, obviously—the coal miners.

But it does not seem to be generally known that the class for whose benefit the Bill was promoted is only moderately in favour of it. The President of the Institution of Gas Engineers, in his address, quoted the Northumberland voting on the question; and it may be as well to repeat the figures. Of 28,725 voters, 10,688 did not vote; 9251 voted for, and 8786 voted against; and this small majority explains the President's own views on the question, based on conversations with the miners themselves. He adds that: "Many are against it; some think it will be all right; but none are enthusiastic." The question, then, naturally arises, Why was the Bill introduced?

All past experience goes to show that a virtually small increase or decrease in the demand for coal has a very considerable, and proportionately much greater, effect on the price. This fact proves conclusively that any alteration in the conditions under which coal is won, having the effect of curtailing the output, will assuredly result in a higher price for it. The yearly demand for coal is so consistent that a shortage of 5 per cent. only is sufficient to occasion a boom in prices. It is, therefore, obvious, where this exists, that any legislation that will have the effect of changing existing conditions is a risky matter.

The miners now have, as is well known, the matter of hourly attendance per week entirely in their own hands—so much so that colliery owners in the Lancashire district have to be content with an average of 36 hours' work per week. Moreover, the worst feature of this low average is that absence from work on the occasions of football matches and race meetings is the rule rather than the exception. All this goes to prove that the miner, with the aid of his Trade Union, is an independent person, without the deterrent, in the form of competition, well known in almost every other trade. Profitable mining is impossible except under conditions where the output capacity approximates to the maximum; for at least one-half of the cost of raising the coal is spent on fixed charges which are practically the same whatever the output. This proportion of the cost is represented by the charges for underground haulage and winding, timbering, and filling-in, ventilation, lighting, pumping, maintenance of tracks, general upkeep and depreciation, salaries, and interest on capital. Thus anything which will tend to reduce the average hours' work per week will seriously increase the cost of winning the coal; for the fixed charges will still be as great, although the tonnage output will be very much decreased. The promoters of the Bill tell us that the reduction in the hours of labour will result in a larger number of men being employed. This is quite erroneous; for the colliery owner knows full well that to show a fair profit he must work his plant to the fullest capacity. He, therefore, takes good care while the plant is running to keep the maximum number of men at work. The question of profit is entirely dependent on the amount of the output. The Miners Eight-Hour Bill proposes to place a statutory restriction on the present output; and the result must be the closing-down of the less profitable pits, and the consequent aggravation of the coal shortage. This cannot but result in a most disastrous effect on a wide range of industries that are dependent, in great measure, on the price of coal.

To make the working day eight hours from bank to bank, means a serious inroad on effective working time. It was shown in the evidence given before the Eight-Hour Day Commission that the average time taken in lowering the full complement of men to the bottom of the shaft is thirty minutes, and the average time in raising them to the bank fifty minutes. The distance from the shaft to the coal-face may be taken as an average of two miles, occupying at least one hour for the double journey. In many cases, however, the distance is so great that no less than two-and-a-half hours are taken to cover this portion of the mine. It will thus be seen that, in extreme cases, nearly four hours may be occupied in getting to and from work. Where such diverse conditions exist, it is surely ridiculous to place a fixed limit on the working day, when the "working day" is calculated from the time of leaving the bank in the morning to the time of reaching the bank in the evening. If a limit must be placed on the working hours, it is obviously more practical to calculate the time on the basis of the hours occupied by the miner at the coal-face itself. If this plan is not adopted, it places the deeper and more extensive mines under a very notable disadvantage. The Bill would seriously hamper the deeper mines—such as the Pendleton Dip in Manchester and the Barnsley Collieries, both of which are sunk to a depth of considerably over 3000 feet. It is obviously far more expensive to open-up at these depths; and seeing that, in the natural order of events all mines are gradually extending in depth, the harmful effects of the Bill are likely to increase rather than diminish. In the same way, the inferior and low-grade coals which are now workable, would, under the new Act, become unworkable.

All these factors tend in one direction, and that towards an increase in the ill-effects of a coal shortage. It is difficult to conceive how any Government could have given such a Bill their support. That they have done so is conclusive proof that the strongest recommendation borne by the Eight Hours (Miners) Bill is its effectiveness as a creator of political support. It is, otherwise, impossible to think that any body of business men could honestly support it from a purely national and economic point of view. As has been pointed out in the "JOURNAL," the Bill, if passed, will offer strong inducements to the colliery owners to adopt machinery; and in doing so they would be following the example of their *confrères* in the United States. It is well known that the production of coal per man employed in America is far in excess of that in this country—a fact entirely due to the liberal use of machinery for cutting out the coal. It is all a matter of the relative cost of manual labour and the capital charges and upkeep of machinery. Capital will usually be found to have the last word unless the admirable system of co-partnership is adopted, when the necessity for the settlement of troubles automatically vanishes. In the case of the mine-owners, there is no immediate prospect of the final settlement of disputes by this method; and so it may be concluded the development of machinery will be greatly encouraged even if the proposed Bill is not passed. The fear of its ill-effects will most certainly turn their eyes in the direction of the displacement of manual labour.

AN EXPERT ON TECHNICAL EDUCATION.

Professor L. C. Miall on "Useful Knowledge."

ONE of the youngest Sections of the British Association, but one with plenty of vitality in keeping with its importance, is that dealing with Educational Science. On the 3rd inst., in connection with the annual meeting of the Association in Dublin, the President of the Section, Professor L. C. Miall, delivered his address. It proved to be a notable utterance; and as in the course of his remarks he referred to technical education, and as his outlook over the educational field in general is applicable to the training of gas students and the gas engineers of the future, it will be of interest and of profit, both to engineer and pupil, to give every attention to the sound views expressed by this educational expert.

Professor Miall took as his subject "Useful Knowledge," which, as he said Hazlitt had pointed out, was not to be confounded with the knowledge of useful things. If we put the difference in our own words, and, no doubt, somewhat imperfectly, we would say that useful knowledge is the acquiring of that learning which is of real benefit in helping to build up a true type of man—a gentleman in the best sense, of strong character, liberal views, and high aims; whereas the knowledge of useful things is the acquiring of that learning which is not directed to the making of a complete man, but merely to the acquisition of a more or less limited number of facts of a utilitarian character. Shortly, we take it, the difference results in what the Latins distinguished by the words *vir* and *homo*. Useful knowledge aims at producing the former; the knowledge of useful things only effects the latter.

In the course of his remarks, the Professor referred to book learning. "The knowledge of books," he said, "may be an excellent form of useful knowledge; it may also, when it strives merely to record and remember, be unproductive and stupefying." He proceeded to quote the protests of great men and minds against unused learning, and, we might add, abused learning. Rabelais was of opinion, as indeed we all know, that the most learned scholars may be far from the wisest men. Montaigne said that "he who knows most is not always he who knows best; that undigested food does not nourish; that memory-knowledge is not properly knowledge at all." Locke held that real knowledge was mental vision, valuing first virtue, then wisdom and breeding, and, lastly, learning. Professor Miall says: "Apply to knowledge what moralists tell us about money. It is only the money that you may expect to put to use within a reasonable time that does you any good; and the same holds true of knowledge. Unused knowledge, like unused money, becomes corrupt. Uncritical, ill-mastered knowledge is at its best a knowledge of useful things."

THE VALUE OF SCIENCE.

The Professor then proceeds to consider the value of science, and to analyze, and ultimately to reject, Herbert Spencer's contention that "for everybody and under all possible circumstances, science is that knowledge which is most valuable." It is only the all-embracing width of this dictum that Professor Miall controverts; for he says: "Science achieved her earliest successes by investigating the simplest properties of tangible things—number, form, uniform motion. Here she learned how to combine the knowledge of many concrete facts into general statements, which (to the confusion of thought) we call scientific laws. Science of any good kind sets up the habit of methodical inquiry and the habit of reasoning. The virtues of science are exactness, impartiality, candour." Though the nation requires scientific knowledge beyond that of any other kind, yet it does not follow that every individual should make science his chief objective. An elementary knowledge of many sciences is nowadays practically unattainable. "The science which is applicable to industry or to public health is steadily growing harder of attainment." But

this is not to be used as an argument for restricting all study of science to the few, for an elementary knowledge of, or a training in, science may be invaluable in its effect upon character and in achieving mental discipline. This leads up to the subject of technical education; and Professor Miall's cautious attitude, but sound sense, will be gathered from the following extract:—

TECHNICAL EDUCATION.

Of technical education I must say but little, and that little must be said with reserve. Technical education may be pursued in at least three ways: (1) We may seek to qualify the pupil for his calling by a thorough training in some science or art, and then, by the application, under the guidance of an expert, of that science or art, to a particular industry. The experience of at least two generations seems to show that this method is really effective; it does what it professes to do. (2) The second method aims at no more than supplying information directly applicable to the industry in question. Surely this is the least profitable of the three. The information is not accurately lodged, either in the memory or in the note-books of the students; it soon becomes obsolete in consequence of the advance of knowledge; and it does little to cultivate intelligence or the power of doing. Where intelligence and the power of doing already exist, mere information may be valuable; but the best storehouse of information is the printed book. (3) Lastly, we may aim at nothing more than facility by repetition. Such practical arts as reading, writing, drawing, needlework, and cookery are largely acquired by imitation and constant practice. Skill in these arts is a tool, whose profitable application depends much upon the intelligence and enterprise of the possessor. Independent attempts to meet difficulties, friendly criticism of these attempts, questioning about the causes of failure are the expedients which a wise and experienced teacher, ever at hand, would employ.

The benefits of literature as a form of useful knowledge are then considered. "Like beautiful scenery, health, liberty, friendship, and other felicities of life, it is good in itself, apart from the advantages it brings. . . . Literature and science are incommensurable." The difficulty of selecting educational subjects, among so many, is obvious. Latin is generally compulsory; then Greek, it is urged, is more interesting; then French and German are demanded. So it is found "that no foreign language, ancient or modern, is mastered to the point at which it can be used in reading, writing, or conversation." The pupil must first be studied in regard to three requisites—aptitude, inclination, opportunity. "Moral character, intellectual character, curiosity, love of knowledge, equipment for practical life, are all considerations which ought to govern the choice of a study." After contrasting natural and artificial education, the importance of obtaining the mastery of something is insisted upon. "Let us try to reach the inner life of something, great or small. The truly useful knowledge is mastery. Mastery does not come by listening while somebody explains; it is the reward of effort. Mastery comes by attending long to a particular thing—by inquiring, by looking hard at things, by handling and doing, by contriving and trying, by forming good habits of work, and especially the habit of distinguishing between the things that signify and those that do not."

This quotation may fittingly conclude our brief summary of a notable discourse, which will amply repay fuller consideration.

THE EXAMINATION OF STEAM-BOILERS.

[COMMUNICATED.]

Now that the insurance and examination of steam-boilers is compulsory, it is hoped that we shall not hear of so many cases of explosions brought about by ignorance or gross carelessness. All engineers having control of boiler plant can call to mind some case or cases where a bad defect has remained unnoticed till too late—sometimes with serious results. It would be very much to the advantage of all engineers and managers in charge of boilers were these cases published yearly or half-yearly by the Insurance Companies. It would, of course, be quite unnecessary to mention the names of the works unfortunate enough to be included in the list.

It may be remembered that Mr. Tysoe in his presidential address to the Southern District Gas Association, in 1903, referred to an accident resulting from the rapid corrosion of boiler blow-off pipes. In this case, a range of four boilers was connected into a 6-inch cast-iron pipe discharging into the river. While one of the boilers was being blown off, a portion of this pipe burst, and the fireman (who was unfortunately just over the spot) was scalded in such a manner as to result in his death. The pipe in question had only been in use for two years; but subsequent examination proved it to be badly corroded at that particular point—doubtless owing to the acid nature of the water dripping from the wet ashes. The writer has found it advisable to scrape and paint the portion of pipe directly in front of each boiler as its turn for letting-down comes round; and in this way, for a trifling expense, it is possible to make doubly sure that corrosion will not take place to any extent.

The author recently heard of an accident which teaches that cast-iron should not be relied upon for the connection between the boiler and the blow-off cock, and also that the connection between the blow-off cock and the main blow-off pipe should be effected by means of a bend—preferably of copper—so that there should be a minimum of rigidity between the boiler and the main blow-off pipe. This is more especially necessary whenever the connection between the boiler and the blow-off cock is of cast iron. That rigid connections should be guarded against is, of course, due to the fact that when one of a range of boilers is being blown-off, there is immediately an expansion of the main blow-off pipe due to the heat; and at the same time a considerable strain is exerted on the extreme end of the pipe. This strain is also obviously repeated in a lateral direction on the connections between the boiler and the main pipe. The lateral strain at this point is minimized where a copper bend is fitted; and it is again advisable to see that the connection from the boiler to the main pipe is as short as possible, so as to avoid the lever action of the strain at this point should the connection be extended to an unnecessary length.

That cast iron is dangerous is evident from the accident in question; for in this case the bend from the boiler to the blow-off cock was of rather more than the usual length and of cast iron. This particular boiler was the first of a range of five, one of which was just being blown off at the time of the accident. At the moment the blow-off cock was opened, the part of the cast-iron bend nearest the cock on the boiler at the end of the range fractured—letting out all the water, and resulting in several serious, although not fatal, scalds. The lessons to be learned from the accident are mentioned above; it is only by unfortunate experiences of this kind that the importance of these essential details is driven home.

Carelessness on the part of those engaged in repairs on boilers, and also on the part of the boiler-firemen is another matter which should be strictly suppressed; for the accidents to men cleaning or repairing empty boilers are almost invariably due to carelessness on the part of someone. It is always dangerous to enter a boiler without having first informed the fireman or other man in charge, and also without having previously made sure that the blow-off cock is shut or the connection blanked-off. In the first place, the blow-off cock may have been removed for repairs. Should this be so and one of the boilers be blown-off, the man inside the boiler would be severely—perhaps fatally—scalded. It would, of course, be gross carelessness on the part of the fireman to blow-off a boiler without having made sure that the empty boiler was disconnected from the discharge pipe, and also on the part of the man who removed the cock for not having it blanked-off. In the second place, the man after entering the boiler or flues might be overcome with sudden illness, or meet with an accident, and be unable to make his presence known before the boiler was put to work. Again, there have been cases where the steam-valve has been accidentally opened—resulting in fatal accidents to those who were inside the boiler.

Another source of danger with empty boilers connected with others under steam, is that due to the steam-valve leaking. This causes much inconvenience to those working inside; and to prevent it men have been known to plug-up the opening with waste or wooden plugs. They have then left the boiler, having forgotten the existence of the plug, with the result that the boiler having been put to work, there has been no outlet for the steam, and an explosion has followed.

In the September number of the "Engineer-in-Charge," a short article appears on "Boiler Inspection and Safety-Valves;" and in it is given an instance of the importance of safety-valves being tested by hand by the inspector. As in this particular case the incident happened at a gas-works, it may be as well to reproduce *in toto* the paragraph in which the facts are related.

In making an external inspection of a boiler at a gas-works on one occasion, it was noticed that the safety-valve was blowing off, and there appeared certainly no necessity, in this instance, to test the lever by hand (which, it may here be said, is a rule with Boiler Insurance Companies). In going past the valve, however, the inspector quite mechanically put his finger under the end of the safety-valve lever, expecting, as the valve was blowing-off slightly, that it would at once puff off more vigorously. But, to his surprise, a slight pressure under the lever made no difference to the force with which the steam was escaping; and he found he could not lift the lever at all. Further examination showed that there was a space of not more than $\frac{1}{8}$ inch between the upper side of the lever and the top of the guard, and that this was filled up solid with fine cinder. The boiler was side by side with the gas-retorts, which are regularly being emptied at the gas-works; and the clouds of fine cinder which arise and fill the place every time the retorts are emptied had filled up this small space till it was solidly full, and the lever could not lift even $\frac{1}{64}$th of an inch. The valve was not steam-tight, and required grinding; and had the inspector gone away without testing the lever by "hand," there were all the conditions for a disastrous explosion through a defective safety valve.

Neglect in keeping the safety valve in good order is undoubtedly responsible for many accidents. It must be extremely annoying for a fireman to work a boiler on which there is a leaky safety-valve. Much of his work must, of necessity, be wasted—a most disheartening position to be in. It is, therefore, hardly surprising should he try and doctor the safety-valve by weighting it.

The same number of the "Engineer-in-Charge" gives another instance of the importance of testing the safety-valve by hand. An inspector was examining a boiler at rest. On coming to test the safety-valve, which was loaded by a lever and weight, he was unable to lift the lever; and further examination showed that the space between the top of the lever and the guard through which the lever passed, had been filled up with a short piece of a file, carefully fitted in the guard. This could not be seen, and would not have been discovered had not the inspector faithfully adhered to his instructions to "test the safety-valve by hand."

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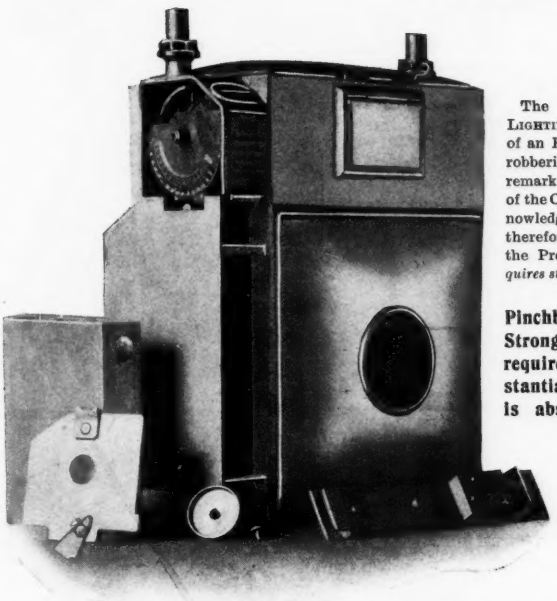

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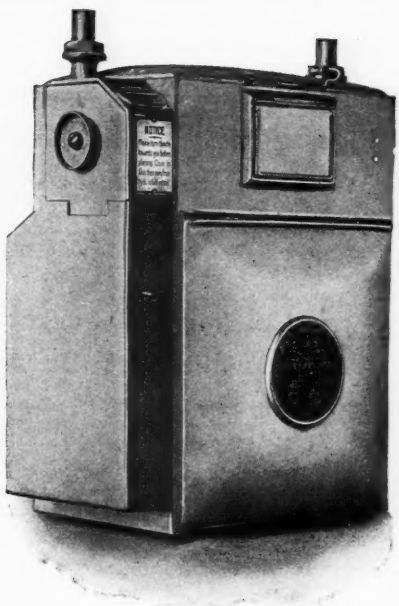

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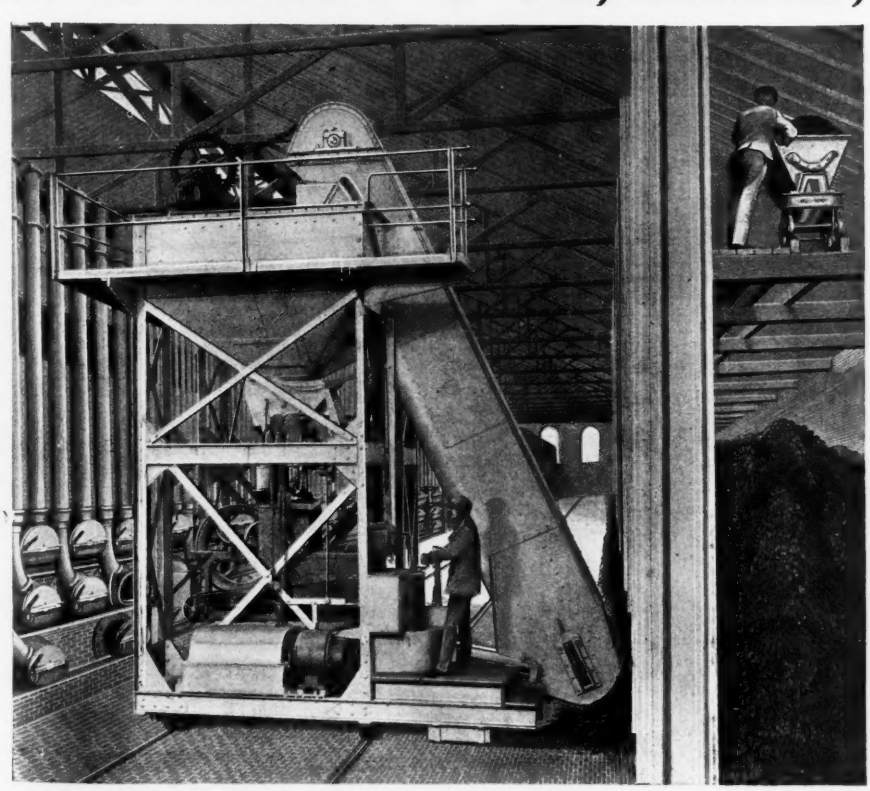

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Fig. 2.

Figs. 2 and 3. Steatite Float Governors for Incandescent Burners.

Fig. 3.

Fig. 4. Leather Diaphragm Governor for Incandescent Burners.

Fig. 4.

ANY SIZE MADE TO ORDER.

Fig. 5. Double and Single Leather Diaphragm Governor for Outlet of Meters.

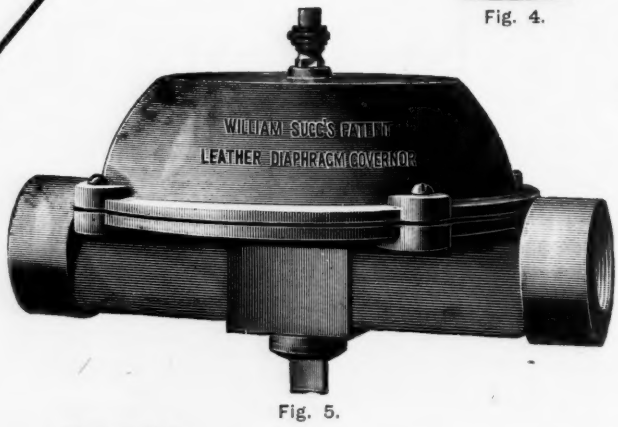

Fig. 5.

Leather Diaphragm Governors are also made for High Pressure Gas up to 80 inches.

Fig. 6.

Fig. 6. Mercurial Seal Governor for Outlet of Meters.

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THE PHOTOMETRIC STANDARD OF THE NATIONAL PHYSICAL LABORATORY.

By R. T. Glazebrook, M.A., F.R.S.,
Director of the National Physical Laboratory.

The photometric standard of the National Physical Laboratory is a ten-candle power Vernon-Harcourt pentane lamp certified by the Gas Referees. The light given by any flame standard of this kind depends, to some extent, on the pressure and humidity of the atmosphere in which it is burning; and for many purposes —in particular the photometry of glow lamps—it is necessary to specify these factors with care. For gas photometry this is less needed, as flame lights are probably all affected in the same direction by changes of pressure and moisture. Hence it was not until the photometry of glow lamps became important that careful measurements of these effects were made in the first instance by Dr. Liebenthal, of the Reichsanstalt. One set of such experiments were laid before the British Association at Cambridge, in 1904, by Mr. Peterson; and these, so far as humidity is concerned, led him to the formula—

$$\text{Candle power} = 10 + 0{\cdot}066\,(10 - e).$$

Where e is the number of litres of aqueous vapour present in a cubic metre of air. It will be observed from this that the lamp has the standard value when $e = 10$; or, in other words, the standard condition of humidity is 10 litres of moisture per cubic metre.* This condition was chosen because it was found that this was approximately the average humidity found during the three years 1897-8-9 both at the Observatory Department of the National Physical Laboratory and at the Meteorological Office. The humidity in this case was measured by the ordinary wet and dry bulb thermometer without any artificial ventilation as generally employed in this country, and the usual formula of production was used. At the Reichsanstalt, in Berlin, however, an Assmann ventilated wet and dry bulb instrument is in use; and at the International Commission on Photometry, held at Zürich in 1907, an instrument of this class was recommended.

This, and the endeavour to clear up certain outstanding differences, has led to a more complete investigation by means of different hygrometers of the amount of moisture actually present under the so-called standard conditions—viz., 10 litres as measured by the ventilated wet and dry bulb instrument when the observations are reduced by the ordinary formula; and the result has been to show that in the extremely still air of the photometer room there is a difference of as much as 20 per cent. between the indications of the ventilated and unventilated hygrometers, while the methods which were tried indicated generally intermediate readings.

According to the Assmann instrument recommended at Zürich, which may probably be taken as giving the more nearly correct result, the moisture actually present is only 8 litres per cubic metre when the unventilated wet and dry bulb instrument makes it 10 litres. If we stipulate that e in Mr. Paterson's formula is to be measured by the Assmann instrument, it becomes—

$$\text{Candle power} = 10 + 0{\cdot}066\,(8 - e)\,\dagger$$

And the standard condition of humidity at which the lamp has the value 10-candle power is approximately 8 litres of moisture per cubic metre, instead of 10 litres by the other method.

Objections may be urged to changing, in this manner, the nominal standard condition. The International Photometric Commission, on the recommendation of the laboratory, accepted 10 litres as the normal standard condition of humidity for the Vernon-Harcourt lamp, and agreed on figures based on this for the ratios of various light standards; and it may be said that these should not now be changed. If this view be maintained, however, it would entail an alteration of about 1·3 per cent. in the photometric standard of the laboratory which has been adopted by the Engineering Standards Committee as the standard for glow-lamp photometry, and hence in the many secondary standards which, in the past three or four years, have been compared with this. In view of the difficulties and confusion caused by such a change, it seems best (for this and other reasons explained below) to maintain the laboratory standard unaltered as to its light-value, and to adopt 8 litres of moisture per cubic metre as the standard condition of humidity. I am glad to say that the Gas Referees concur. Professor Boys, writing to me on May 28, 1908, says: "My colleagues agreed that the degree of humidity represented by 8 litres of water vapour in a cubic metre of air as measured by the Assmann apparatus—seeing that it is commonly met with in this country—is one which may very properly be taken as standard; and they recognize the advantage for international purposes of the very simple relationships of the three primary standards which follow from the selection of this degree of humidity."

Professor Boys's last sentence relates to an important consequence of the change—first pointed out to us in correspondence with the Bureau of Standards of America. Experiments on the ratio of the hefner to the pentane lamp were made during 1906-1907 in France, Germany, and England, and communicated to the International Commission on Photometry at Zürich. Dr. Liebenthal, working at the Reichsanstalt, found for the ratio of the hefner candle to the pentane candle, when burning under identical conditions of moisture, pressure, &c., the value 0·909; while Mr. C. C. Paterson's value at Teddington was 0·907. Messrs. Perot and Laporte found a slightly higher figure. Between ourselves and the Reichsanstalt there is exact agreement. But the standard condition at the Reichsanstalt is 8·8 litres of moisture; that at Teddington was 10 litres, as measured by the unventilated hygrometer, and since found to be 8 litres measured by the ventilated instrument.

In either case, to get the ratio of the standard hefner candle to the standard pentane candle, a correction is required for the difference in the standard humidity value, which can be obtained from Mr. Paterson's formula, and the above result that—

$$\frac{\text{Hefner candle at 8·8 litres}}{\text{Pentane candle at 8·8 litres}} = 0{\cdot}908$$

Taking 10 litres as a standard, we have—

$$\frac{\text{Hefner candle at 8·8 litres}}{\text{Pentane candle at 10 litres}} = 0{\cdot}915$$

And this is the result accepted at Zürich with a margin of + or − 1 per cent.

If we accept the readings of the Assmann hygrometer, and treat 8 litres as the standard condition for the pentane lamp, then—

$$\frac{\text{Hefner candle at 8·8 litres}}{\text{Pentane candle at 8 litres}} = 0{\cdot}903$$

And this figure is so near to 0·900 that we may certainly say for practical purposes, within + or − 1 per cent., that the standard hefner candle is nine-tenths of the standard pentane candle.

Moreover, according to comparisons between the French standard, the carcel lamp, and the pentane lamp made by the same observers, the value of—

$$\frac{\text{Bougie decimale* at 10 litres}}{\text{Pentane candle at 10 litres}} = 1{\cdot}02$$

If, however, we take the pentane at 8 litres, this becomes—

$$\frac{\text{Bougie decimale at 10 litres}}{\text{Pentane candle at 8 litres}} = 1{\cdot}006$$

Or within sufficient approximation for all practical purposes, the two are equal.

So that, on this basis, and to a sufficient approximation for all practical work, the standard pentane candle is equal to the Bougie decimale, and each is ten-ninths of the hefner candle.

These constitute the very simple relationships to which Professor Boys has alluded, and afford, we hope, a strong ground for accepting 8 litres as the standard value for humidity for the pentane lamp, and for asking the International Commission, at the proper time, to revise their decision to take the value 0·915 as the ratio of hefner to pentane candle, based as it was on the information which was laid before them by the laboratory.

The change does not completely remove the discrepancy which is known to exist between the ratio of the hefner to the pentane candle, as found by direct comparison and through the intermediary of electric lamps. This ratio, obtained by carrying lamps, carefully selected, between the Reichsanstalt and the National Physical Laboratory by various observers is as follows:—

Paterson, 1905	0·891
Fleming, 1905	0·886
Sharp, 1905	0·890
Hyde, 1906	0·894
Mean	0·890

The difference between this and 0·903, as found by direct comparisons, is over 1 per cent.; and although the discrepancy has been reduced considerably by the change in the latter ratio from 0·915, something still remains to be discovered. This point, we hope, with the co-operation of the Reichsanstalt, to investigate further.

There is another point, with regard to the measurement of the humidity, to which allusion should be made. In our work at the National Physical Laboratory we have generally defined this as the number of litres of moisture in a cubic metre of pure dry air. Dr. Vernon Harcourt has, however, pointed out in a letter that it is usual to consider the total volume of all the gases concerned, and that it would be more in accordance with chemical practice to take the ratio of the number of litres of moisture in an actual volume of 1 cubic metre including the moisture, CO_2, and other gases which might be present. The practice we have followed is that of Dr. Liebenthal, whose well-known researches were the first on this subject. To the degree of accuracy to which we are working either method leads to the same result. It may possibly be well in future to adopt the plan generally approved by chemists, provided other countries concerned agree.

* The Bougie decimale is taken as 0·104 of a carcel.

* See also the last paragraph of this report.

† A complete series of experiments has shown that the constant 0·066 in the formula holds both for the ventilated and unventilated instruments.

The French Section of the Franco-British Exhibition.—La Compagnie pour la Fabrication des Compteurs et Materiel d'Usines à Gaz are exhibiting in the French Section of the exhibition, a 300,000 cubic feet station meter, and various consumers' gas-meters, manufactured under the "Duplex" system. We understand that the British patents covering the system have been purchased by Mr. Frank Thorp, of Whitefield, near Manchester, for a new Company now in course of formation. Two of the first Directors will be Mr. T. G. Marsh and Mr. Thorp.

THE RICHMOND GAS-HEATING IMPROVEMENTS.

SERIOUS complaint as to the want of originality in gas-fire design has now ceased. There was a time when the complaint had real ground, and the censure conveyed was deserved. But competition and demand have set this right; and it is now a matter of the past. The range of design is such that no gas manager or householder has to make a wearisome search to find what he requires for his special purposes. This year the Richmond Gas Stove and Meter Company are not offering new designs in the casings of their fires; they have been taking note of requirements in details, and have set themselves to satisfy these requirements.

"Castilian Fire," showing Boiling Ring and Damper Lever at Side, and Cast-Iron Plate Back.

Last season the firm presented a series of new designs, known as the "A" "B" "C," or the "Arabian," the "Bavarian," and the "Castilian." These designs, we learn, became quickly popular, both on account of exterior attractiveness, and the intrinsic value attaching to them for maintenance purpose. And relative to the latter point, it may be recalled to mind that the series was made with 10 and 13 inch fires, that only in the casings was there any difference, and that the 10-inch fire and auxiliary fittings would fit any one of the three casings made for that size of fire, and the same remark applies to the 13-inch fire. The interchangeability obtained reduced to the minimum the stock of parts necessary for the gas-fittings department of a gas undertaking for maintenance work. Subject to what we have to describe, the Company are satisfied that they are doing the correct thing in keeping to these designs for the coming season.

In the first place, there was only one of these fires fitted with a top boiling-ring—that was the flat top "Bavarian" fire; the other two designs with rounded or curved canopy were not so fitted. But it has been found that some people, while they prefer the appearance of the ornamental top fire, bemoan the fact that their preference could not be complied with without abandoning the convenience of the boiling-ring. Utility and efficiency are of the strong recommendations for gas among the general public; and all possible must be done, with as little sacrifice of any point as possible, to comply with diverse desires. Therefore for those who require one of the rounded or ornamental top fires of the "A" "B" "C" series, the firm have fitted them with a side swivel boiling-ring. The ring is of natty appearance, and is supplied with gas from the fire fittings below. It really looks like nothing more than a circular trivet on a side support, and when not in use, it can be swung away from the front level of the fire. When in use, it can be brought close to the front of the fire; and the top being below the level of the canopy, any escaping fumes are drawn, when the fire is in use, into the canopy, and so find exit to the chimney. The addition of this convenience to the ornamental top fire will undoubtedly prove a recommendation.

There has been considerable discussion on the question of dampers for gas-fires. With chimneys varying in sectional area, height, and position, there is no doubt that something of the kind is needed. Take a chimney in which there is a very rapid updraught, it has a serious effect upon the efficiency of the fire by the extraction of the heat without some means of checking the robbery. But in applying dampers to gas-fires, it is essential that they should be of a character that will make it impossible for consumers to carelessly produce trouble in regard to the products of combustion. The Richmond Company have applied (to special order) a very simple form of damper to their fires with which no such trouble can be occasioned. The damper is fitted in the exit-pipe. It is merely a loosely fitting circular plate, with the top cut away, so that (even when closed) there will always be a minimum outlet for the products of combustion. The damper is operated by a little brass ratchet fitment at the side of the fire. When the catch is down in the lowest position, the damper is closed, and there is the minimum outlet; lift the catch to the second position, and the damper is half open; lift it to the top position, and it is fully open. A set-screw will be provided, so that, if the consumer does not want the trouble of regulating the damper as occasion arises, the gas-fitter, when installing the fire, can fix the damper in the requisite position that tests suggest to him as being the best.

Improvements have also been effected—not large ones, but useful—in the gas and air adjuster, which improvements have made the burner still more silent. Sloping reflecting fenders can also be had to assist radiation. But another feature is the cast-iron plates (made in different sizes) for adapting ordinary fireplaces for gas-fires. There is nothing of a makeshift appearance about them. They are substantial, and are ornamented in character with the "A" "B" "C" series of fires. If stock sizes are not quite of the dimensions needed, ornamental slanting wings are provided, so that there can be adjustment to almost any angle at the sides. This is an instance of how sightliness and facility in both fixing and cleaning are among the improvements that have accompanied the rise of heating efficiency in connection with gas-fire work. These backs can be had finished in porcellanite or black, to match the fires; and, by-the-by, the porcellanite finishes for fires have been improved year by year, and a very clean surface is now obtained. Colours for which there is not much demand have been displaced this year; and new ones—neutral green and heliotrope—have been introduced.

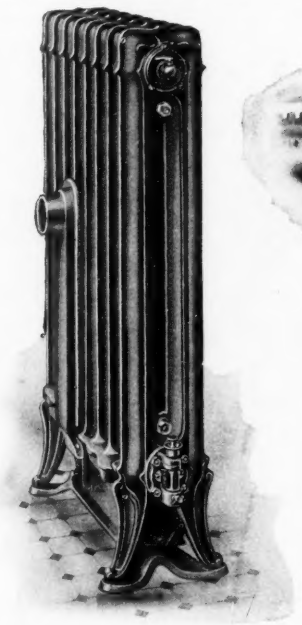
Next we have a novelty that is sure to appeal to gas managers desirous of adding to the attractiveness of their show-room and office windows. Diminutiveness in some things is as attractive as massiveness; and it is so in this case. The Company have made a complete working model of one form of their newest series of fires, complete in every particular. The fender, grate, fuel, fire-clay back, the burner (fitted with gas and air adjuster) can all be

The Miniature Fire.

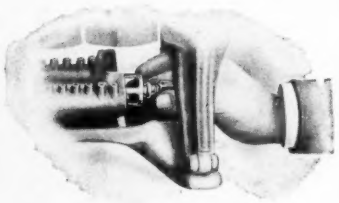
taken out to show customers on a table how easy it is to keep a gas-fire in perfect working order; and the same fire can be shown in use in the show-room window, the consumption of gas by it being so small as to be negligible. As a matter of fact, the whole model, complete in every respect, only weighs 8½ lbs. The outside width of the casing is 8¾ inches, and the depth from the feet to the top of the rounded head 11 inches. Gas-fires are not things that can be carried about like a Gladstone bag; but the Company's travellers will now be accompanied by one of these interesting models.

The gas-steam radiators of the firm for this season continue, with improvements, the principles and the external design that obtained last year. The first thing noticed is that a simple air-releasing-cock has been introduced for removing, when starting the radiator, any air block in the top. Previously merely a thumb-screw was used for the purpose; consequence, danger of the hand being burnt by the steam. The new air-releasing cock is operated by a small lever; and the air escapes at the bottom of the valve until steam issues—all danger being thus averted. In connection with the gauge-glass, an improved method of filling at the top is found. A difficulty with gas-radiators has been the time occupied in filling; but by the improved system it can be done in from one to two minutes. The less trouble a consumer has the better. The method of cleaning the gauge-glass has also been facilitated. The combination of the gauge-glass and filler likewise enables the emptying of the radiator to be effected in less than half a minute; and the aperture into the boiler is now

so direct that a brush can be readily inserted for cleaning purposes. The radiators this season are to be sent out with three brushes—one for cleaning the gauge-glass, one the boiler, and one for clearing out the dust from between the tubes. A white enamelled base plate has also been introduced. It gives a finished appearance to the radiator, and catches any overflow when filling the boiler. From the economical standpoint, there is perhaps nothing to equal gas-steam radiators for heat efficiency;



Radiator, fitted with Flue and Connection.



Gas and Air Adjuster.

Shows act of filling Boiler. Gauge Glass and Guard.

but they cannot be used in all places without a flue. To overcome the objection, while the same efficiency cannot be claimed, the radiators of the firm can also now be had with a flue. The base of the radiator is of rather larger construction than ordinarily, and from this enlarged base the flue connection is led for the removal of the products of combustion. The radiators are all fitted this season with air and gas adjusters. Besides black, the radiators are finished in red, green, and chocolate.

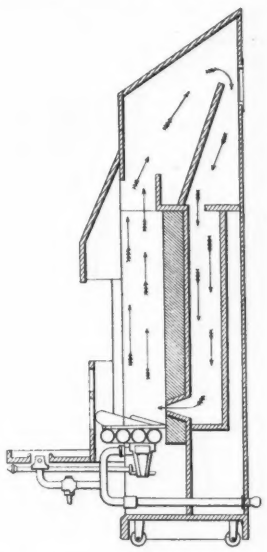
THE HEATING OF MOTOR GARAGES.

WHILE those connected with gas undertakings have suffered the universal nuisance occasioned by motor cars, and, in not a few cases, have helped to contribute to the nuisance, they have perhaps not so much to complain of as those who have no likelihood of personal benefit or pleasure accruing to them from the new comers. A large amount of tar has been disposed of for surfacing roads to suppress the dust nuisance, and that is an advantage that would not have been booked by gas undertakings had motor cars not come into existence. But there is another field that they have opened up, and that is in the utilization of gas for heating garages by a hot-water circulating system. In every town garages are to be found; and now that the winter is near, their owners should be approached with a view to obtaining the order to instal a heating system. This year the Richmond Gas Stove and Meter Company have taken up this matter, and draw special attention to it as a source of new business. They have devised for the purpose a new conical gas water-heater, which is small for the duty it renders, is reliable and simple, and, so far as is possible for such service, is economical. Of course, the same heater is applicable for greenhouse and other structures. In external feature the heater rises in conical form from the base. Removing the upper portion from the base, it is seen that there is inside a centrally situated conical boiler; and there is to the outside shell of the heater an inner ribbed casing—the outer shell and the inner casing forming an annular space, into which water from the central boiler feeds. The iron ribs built into the inside casing act as conductors of heat to the water in the annular space. The cone shape, too, of all the upper parts, tends to the larger utilization of the available heat. In the base the burner swings out for the purpose of lighting up; and it is fitted with a gas and air adjuster. An hourly consumption of 15 cubic feet of gas is sufficient for 60 feet of 2-inch circulating-pipe. All connections are provided to the boiler, so that fixing up is a matter that can be expeditiously done.

The President of the Local Government Board has arranged for the making of a chemical and bacteriological investigation, by Mr. C. G. Moor and Professor R. T. Hewlett, as to the influence of softening and of other chemical processes on the purity of water supplies from the chalk, as shown in actual experience and under experimental conditions.

A FUME DESTROYING GAS-FIRE.

FOUR years ago there appeared in the "JOURNAL" (Oct. 4, 1904) an account of a self-regulating gas-burner with which Messrs. Smith and Co., of 19, Torrens Square, Stratford, were identified; and now our attention is directed by them to a new gas-fire, for which there are claims that the inventors are quite willing to substantiate to anyone interested. The patentees are very well satisfied with the success of their efforts; but as we have not yet had an opportunity of seeing the stove, excepting as depicted by drawings, we cannot vouch for the accuracy of all claims.



A vertical section (reproduced) and a transverse sectional plan show a fire with a four-coiled burner, the construction of which promotes the admixture of the gas and air, and so ensures complete combustion. The burner nipples also contain gauze discs ½ inch down from the orifice; and this prevents flashing or lighting back. The dome of the fire is constructed of solid castings, so that as the hot products of combustion ascend, there is no possibility of any escape into the room. In the interior of the dome there are also baffles; and the heated products pass over these, then down a chamber in the back of the stove, and through a nozzle in the back brick into the fire; so that there is, the patentees say, practically complete destruction of all that is deleterious. This cycle of action continues all the time the fire is alight. Mr. Smith states that, in his experience, no flue into the chimney is required; but he has made provision for one, so that any prejudice may be overcome. We rather incline to think that the flue will be generally preferred. However, one other point is that the fire is on castors. The patentees also add (if required) a boiling-burner at the lower part of the front of the fire; and this can be used independently of the latter. To supplement the artistic appearance of the fire, and for the convenience of reading, the fire casing is (if desired) also fitted with incandescent brackets and burners. The low position of these for really useful lighting is questionable; but they will meet the fancy, as a novelty, of some householders. These, however, are auxiliaries that are purely optional; the fire as first described is the main feature. The fires can be had in various styles of finish.

The "LA" "Omega."

THE "OMEGA" HEATER.

ATTENTION is desired to a new departure in the "Omega" gas heating system. It is found in the pattern "LA," of which an illustration is given. The internal structure is so arranged that, in addition to the Company's unique method of hot-air circulation by a jet of gas, there is diffused through a ruby square a warm, cheerful glow. Therefore, as well as being hot, this type of heater looks hot. The height is only 26 inches; and the size at the base 12 inches square.

Full on, the gas consumption is stated as being only 10 cubic feet an hour at 2 inches pressure. It is certainly a stove that should find a large field of use in offices and small shops.

INDUCTION CONDENSING GAS-STOVES.

From their great variety of gas heating stoves, the Carron Company chose their patent induction condensing gas-stoves for special mention. To warm the air without vitiating it is very desirable; and this it is claimed is done by their method—the products of combustion being condensed by passing through tubes, and therefore no flue is provided. Readers who are not acquainted with these stoves will be interested in the following explanation of the makers as to the principles of their construction and operation: "The action of the apparatus is caused by the hot gases, which emanate from the point of ignition, after flowing into a chamber where they expand, being conducted down cast-iron tubes on each side, where, on arriving about midway, they are partially condensed or turned into vapour. The liquid, after flowing into the base of the apparatus, is carried through a small aperture into a receptacle provided for it. The vapour is induced through smaller tubes on each side to the upper part of the apparatus, where it comes into contact with the hot gases, and, mixing with them, finds its way among all the particles, so as to fully saturate them, expands, and increases the expansive force, which causes the condensation, and vaporization in the side tubes. By this system, more than double the condensed fluid can be obtained from hot gases, than it would be possible to obtain from a much larger apparatus constructed on any other known system." In the construction of the apparatus the following laws with regard to condensation, evaporation, and vaporization are carried out: "That the quantity of vapour existing in any given space depends entirely upon temperature, and is not influenced in any respect by the presence or absence of air or any other elastic fluid. That vapour unites mechanically with the air, and does not combine chemically. That vapour finds its way among all the particles of the air so as to fully saturate them. That evaporation is not dependent on any chemical affinity subsisting between air and water. That the rate of evaporation is increased or accelerated or impeded, just in proportion as the density of the air in contact with the evaporating liquid is increased or diminished. That vapours are obedient to the same law as gases with respect to heat, if the vapour is kept apart from any sensibly evaporating fluid, and until its temperature is reduced below the limits of saturation. That the vapour must be kept quite separate from the evaporating fluid, and its temperature maintained sufficiently high to prevent any part of it from reverting to a liquid state. This applies equally to gases or vapours when mixed, but neither the gases nor the vapours must have any chemical affinity for each other. That the expansive force of dry air at any particular temperature added to that of aqueous vapour of the same temperature is exactly equal to their joint expansive force." It is stated that this is the most economical method of obtaining heat. "Taking coal at 25s. per ton, and gas at 3s. per 1000 cubic feet, the stove gives a heating effect equal to a coal fire at 20 per cent. less cost; and the same heat is produced by this stove as by a gas-fire set in an ordinary grate at one-third of the cost."

Patent Hygienic Induction Condensing Gas-Stove.

COMBINED GAS BOILER AND BATH.

Cleanliness has a high place among the virtues. A combination of boiler and bath which takes up a comparatively small amount of space, but gives a maximum of convenience, has just been brought to our notice by Messrs. Ellkay and Co., Limited, of Upper Thames Street, E.C., as a suggestion for additional scope for promoting gas consumption. The combination is a cheap one; and it has been specially designed for providing the means for giving a bath and a supply of hot water in workmen's dwellings, cottages, flats, and tenements, at a minimum cost for both gas and coal. The combination provides both bath and boiler in the space generally occupied by the bath only. The gas-boiler is fitted with a 12-gallon copper pan, steam exhaust, nozzle for vent-pipe and controlling damper. It is strong, simple, and efficient; and not only is it useful for giving a hot bath quickly at low cost, but it provides a very useful boiler for laundry and other purposes, while the bath is handy for rinsing the clothes. The draw-off tap is, of course, available for ordinary domestic use. The over-all dimensions are 5 ft. 3 in. to 6 ft. long, and 3 ft. 4 in. to 3 ft. 7 in. from floor to top of boiler, according to the size of the bath. For better class dwellings—bungalows and villas—a porcelain enamelled bath is provided at a small extra cost. We are informed that certain gas companies are arranging to sell the combination on the hire-purchase system for the convenience of their consumers in the coming season.

NEW LAMPS AND OLD LAMPS IMPROVED.

Messrs. Parkinson and W. & B. Cowan, Limited.

It goes without saying that lamps for street lighting form a very important department in the business of the above-named firm. Good workmanship brings unaided a reputation; and reputation success. The first illustration shows one of the firm's popular

Parkinson's (No. 840) Wind-Proof Lantern.

Parkinson's (No. 801) Storm-Proof Lantern.

wind-proof patterns; but the newest addition to their range of lanterns is the No. 801 "Storm-proof" lantern. This is claimed to be thoroughly wind-proof, and so fit for use in the most exposed

positions. Both lanterns are strongly constructed of hard rolled copper throughout; and the four astragals are strengthened with tinned iron rods running from top to bottom. They are also fitted with removable porcelain earthenware reflectors, and a central flue to prevent all down-draught. Messrs. Parkinson and W. & B. Cowan are makers of all classes of brass work for street lighting, among their specialities being the No. 9 anti-vibrator, which can be had fitted with any class of upright incandescent burner, and provides for both lateral and vertical vibration. The firm have prepared an attractive six-page leaflet illustrating various designs of lamps and fittings.

Messrs. Guest and Chrimes.

One of the specialities of this firm with which they are approaching the coming lighting season is Cowan's patent upright inverted incandescent burner for four ordinary inverted mantles. The burner is fitted complete with needle gas regulator, pilots, and bye-pass lever lantern cock. This cluster light is designed for use in existing lanterns; and it can be installed without any alteration to the lanterns in any way—the needle regulator permitting of the burner being adjusted to the local gas pressure. The burners are made for two, three, four, or five mantles. The firm are also making this patent burner with a midnight arrangement, enabling all the lights but one to be extinguished at midnight, and the final light at dawn. The burners are likewise made and fitted with Gunning's patent controller, automatically lighting all burners at dusk, extinguishing all but one at or about midnight, and the final light at dawn—thereby effecting a considerable saving in labour, gas, mantles, glasses, &c.

Cowan's Upright Inverted Cluster Burner.

A Lamp for Maintenance.

An extra strong lamp, as shown in the second illustration, is being introduced by the firm. It is designed with a cast-iron case, coated inside and outside with vitrified porcelain enamel. This lamp is made to take Cowan's patent upright inverted clusters or Welsbach-Kern burners. As a maintenance lamp, it has much to recommend it.

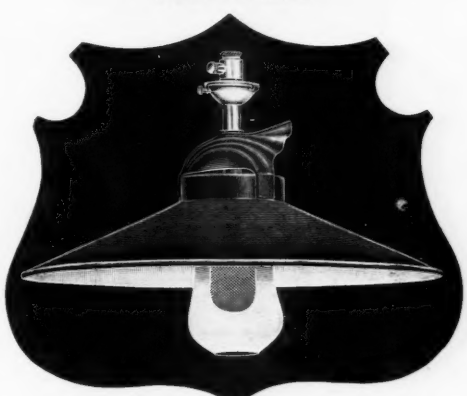
The Bland Light Syndicate, Limited.

It is a striking exemplification of the fertility of the gas-lighting industry when one sees a firm spring into existence, progress, and extend the patterns of lamps they have to offer—yet all made on the same fundamental principles, and so bearing a marked family likeness—in such a short time as the Bland Light Syndicate, Limited. From their commencement they have not been idle in the production of new models for acceptance; and for the coming season, we see among their patterns still further advance. For example, take the "S.I. No. 1" burner, which is one that can be looked upon as being suitable for universal application. It can be fitted up with an inner cylinder and an enclosed globe; thereby making it a self-regenerative burner, and increasing its lighting duty (we are informed) by upwards of 15 candles. The same burner can also be fitted with any ordinary stock globes and mantles, or with the Syndicate's own combination of glass. The burner shares company in make with the older "A" type; but a perforated gallery has been fitted in place of the plain one for the admission of air when an inner chimney and enclosed globe are used. When an ordinary globe with a hole at the bottom is employed then, of course, the inner cylinder is not necessary. The "S.I. No. 1" lamp is illustrated; and a second block shows the same burner with the No. 6 glass combination. The factory, shop, and warehouse burner, is now being supplied, to meet demands, with 12-inch enamelled iron shade and reflector. The bijou form of burners, it is remarked, have not been neglected in the season's improvement; and the effectiveness is not limited to efficiency but extends to general style. One form is shown. The

Bland Bijou B. Burner.

Bland "S.I. No. 1 Universal."

Bland "A." No. 6.



Bland "C. No. 7" for Factories, &c.

"A" burner can be obtained with the firm's patent mantle carrier, by means of which the mantle hangs independently; and this, it is maintained, greatly increases the life of the latter. If required, too, the burner can be had fitted with a nozzle that will take any make of mantle. It will thus be seen that the Syndicate leave customers for burners free choice between their auxiliary fittings and those of other firms. These are a few points out of a number which range along many burners useful for all lighting purposes and an excellent variety of pendants and brackets.

Messrs. E. C. Hayward and Co.

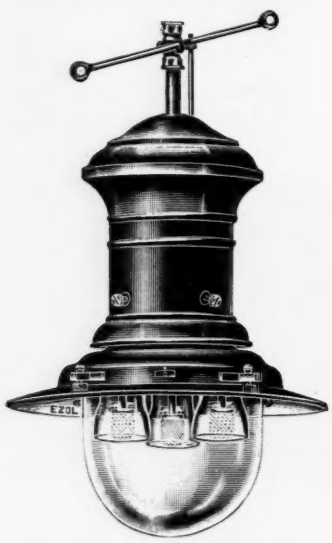
In the "Bedford" inverted single burner lamp, we have for the size, a powerful source of light. It is of the regenerative type; and while the illuminating power is good, the vendors assure us that with the lamp there is no noise, carbonization, or back-firing. The arrangements permit of instant adjustment to gas of differing composition and pressures. A special feature is the self-centring spring to hold the globe, which, while facilitating the

placing of the globe in position, prevents its fracture from heat. For use in mills and factories, an anti-vibrating arrangement is provided—constructed entirely of metal. A recommendation of the lamp is that it will take standard mantles and glassware.

Wholesale Fittings Company.

A communication from the Wholesale Fittings Company puts us in possession of information as to certain of the changes in design and other improvements effected in their lamps. One improvement in burners relates to the "Ezol" lamp introduced last year, and which is now known as the "New Ezol." Structural alterations admit of an inner glass chimney and an improved form of globe, with perforations round the mantle line.

The first of the new models is the "Starco" self-regenerating lamp, consuming less than 3 cubic feet of gas per hour, and giving, we are informed, from 100 to 120 candle power. Besides the glass cylinder, the special feature is the method whereby air is introduced from outside through three tubes. The arrangement, it is claimed, obviates explosion at lighting, hissing during burning, and lengthens the life of a mantle. Another lamp with an internal cylinder is the "Transpero," in which, however, a mica



The Outdoor "Ezol."

"New Ezol" Lamp.

The "Starco" Lamp.

The "Transpero" Lamp.

chimney is substituted for glass; and being considerably longer than the ordinary pattern, it is carried into the head of the lamp, which is enclosed by an attractive glass corona. A special feature of this invention is the combination of the parts whereby the shade and its carrier, the corona, and the talc chimney, all come away together to admit of access to the burner and mantle. Connection between the fixed and the movable parts is made by a slip bayonet joint.

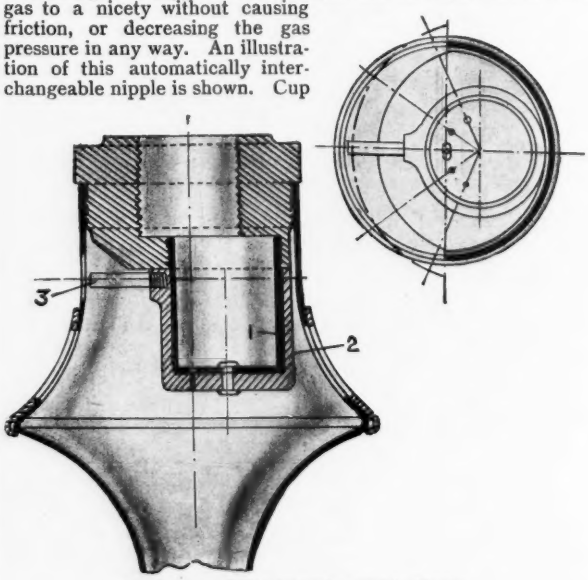
For indoor lighting, where a large candle power is required, the "Betall" is introduced. This is a three-light cluster controlled from one cock; but each burner is supplemented by a needle-valve allowing the unit lights to be thrown out of use if desired. No shade is used, but the lights are protected, and incidentally the efficiency is enhanced, by the use of a large diameter cylinder surrounding the three mantles. The illuminating power is stated by the Company to be about 360 candles when all the burners are going. An enamel shade at the head of the lamp focusses the light in a downward direction.

The "Khoma" Gas Arc Lamp, Limited.

The "Khoma" Gas Arc Lamp, Limited, are bringing out this season an improved outdoor lamp made with three or four inverted burners. They claim to have increased the efficiency of their lamp over last year's design, by the adoption of an ingenious patented arrangement of flues—the individual flues of each burner finding exit into one main flue in the centre of the lamp. The outside casing of the lamp is thus kept of such dimensions and shape as to make it a very pretty and attractive design indeed. The lamp is of British manufacture; and the outside casing is made in either copper or enamelled steel. It is perfectly storm proof—having proved itself in this respect in high winds prevailing last winter at Newcastle-upon-Tyne, where the Gas Company have installed a large number of the lamps for street lighting. The revolving shutter on the body of the lamp allows ready access to both the air and gas regulators of the burners. They can be adjusted while the lamp is burning, rain and wind not interfering.

The "Khoma" Outdoor Lamp.

Another improvement which is of great importance to the maintenance department of gas undertakings is the ease with which the burners can be removed for cleaning. One has only to unscrew the nozzle to each burner to remove the entire flue, leaving all the burners in sight, and readily accessible. Only the heads of the burners are in the heat zone; and they are constituted of unbreakable silicon composition having low thermal conductivity. The metal part of the burner being outside the heat zone, the burner tube itself remains cool. This is considered by the firm to be most important, "as hot gases in an inverted burner have a tendency to rise, and thus counteract the downward flow of gas and air in the burner impelled by the injector." Probably the most important feature of the "Khoma" outdoor inverted lamp is the fact that each burner is equipped with a patented automatically interchangeable nipple, which enables one to adjust the flow of gas to a nicety without causing friction, or decreasing the gas pressure in any way. An illustration of this automatically interchangeable nipple is shown. Cup

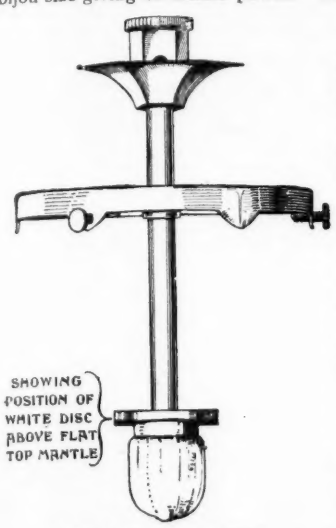


The Automatically Interchangeable Nipple.

No. 1 is fixed, and has in it only one gas orifice, which is concentric with the axis of the burner tube. Cup No. 2 fits over No. 1 with a ground joint, on which it revolves. Cup No. 2 has five orifices of different sizes and capacities, which can alternately be brought into coincidence with the one orifice in cup No. 1. Thus by pushing the lever No. 3 to right or left, one increases or decreases the flow of gas. There can be only one jet of gas, which is always in the centre of the burner tube. In operating the regulator, the burner is not extinguished, for at the moment one orifice is closed the next one begins to open.

MESSRS. INGRAM AND KEMP, LIMITED.

A new and simple type of inverted burner has been put on the market by Messrs. Ingram and Kemp, Limited. It is known as the "Forward," and is made in two sizes corresponding with the ordinary large size giving 65-candle power, and the ordinary bijou size giving 20-candle power. The advantages claimed for these burners are marked. The "B," or small size, consumes only $1\frac{1}{3}$ cubic feet of gas per hour, and burns 24 hours for 1d., with gas at 2s. 6d. per 1000 cubic feet. Thus in an ordinary six-room house, with 12 of these burners all the lighting of the household would not cost more than $\frac{1}{2}$d. an hour. A small dining room, 13 ft. by 12 ft., with a bay window, is well lighted with three of the burners; while one burner is sufficient for an ordinary bed-room, hall, or lavatory. One of the features of the burners is the utilization of a closing disc on the top of the mantle, by means of which the makers aver "all the heat generated by the flame within the mantle is forced to pass out through the fabric of the mantle, instead of creeping up the central tube of the inverted burner." Though any mantle now on the market may be used with the burners, flat-top mantles are recommended as giving the best and most economical results. The foregoing remarks apply equally to the large size burner.



The "Forward" Burner.

Messrs. Ingram and Kemp send a comparison of costs for equal volumes of light as given by these burners and metallic and carbon filament electric lamps, together with the cost of maintenance in each case.

"B" size "Forward" Gas-Burner: Gas at 2s. 6d. per 1000 cubic feet, $\frac{1}{24}$d. per hour, or 24 hours for a penny.

Electric Metallic Filament Lamp: Electricity at 5d. per unit, $\frac{1}{8}$d. per hour, or eight hours for a penny.

Electric Carbon Filament Lamp: Electricity at 5d. per unit, $\frac{2}{5}$d. per hour, or $2\frac{1}{2}$ hours for a penny.

"A" size "Forward" Gas-Burner, 65-c.p.: Gas at 2s. 6d. per 1000 cubic feet, $\frac{1}{10}$d. per hour, or ten hours for a penny.

Electric Metal Filament Lamp: Electricity at 5d. per unit, $\frac{1}{4}$d. per hour, or four hours for a penny.

Electric Carbon Filament Lamp: Electricity at 5d. per unit, $\frac{9}{10}$d. per hour, or 67 minutes for a penny.

"Forward" burners are now being fitted to lamps of the self-intensive type, and are said to be giving exceedingly satisfactory results as regards candle power for a small consumption of gas.

MESSRS. FALK, STADELMANN, AND CO., LIMITED.

This firm approaches the lighting season with a large stock of many varieties of lamps. One of the several in which they are anticipating to do a substantial amount of business is the "Vesta-Veritas" lamp, a description of which was given in the "JOURNAL" for July 21. This is an improved inverted lamp; and since our previous notice, it has been produced in varied style—for instance, in enamelled steel and real copper, with ordinary lever cock action; with plain parabolic reflectors; with parabolic reflectors, having a name slip suitable for the insertion of a lettered panel; with a device which permits of ignition from the exterior of the casing. Another model is provided with a removable outer casing, permitting inspection, repair, and cleaning of the vital parts without the necessity for disconnecting the lamp from the service.

It is seen, too, that the "Metropolis" high-candle power low-pressure burner has been materially improved, and its range of patterns and scope of usefulness enlarged. Special attention should, perhaps, be called to the fact that all the burners are now fitted with adjustable gas-injectors, and that a simple and very businesslike anti-vibrator has been made. By reason of the demand, they are also provided with a gallery, which enables the fitting of the burner with the orthodox wind-proof set, comprising either 7-inch or 9-inch enamelled top, glass bowl, and inner cone. The bye-pass, which is supplied in conjunction with these burners, is strongly made, and accurately adjusted.

Another important item is the "Universal" inverted burners and clusters for conversion purposes. In response to repeated demands, the firm have evolved a one-light bend-over burner, and two and three light clusters, which can be fitted to existing vertical outlets. These burners are provided with micrometer adjusting gas-injectors, flashing bye-passes and glass carriers. The glasses utilized are of the "Graetzin" type, but the mantles with which the combination is completed are of standard type—not "Graetzin." The results are excellent, the burners noiseless and brilliant, and they can be applied to any lantern irrespective of size. The "Universal" wind-proof set should prove of interest to a number of gas companies who may be desirous of making a change at once from the old flat-flame lamps to the inverted incandescent system. This is an adaptation of the bend-over burner to the enamelled wind-proof set, and has been found to answer perfectly under most adverse conditions.

The "Universal" Wind-proof Inverted Burner Set for Street Lighting.

The "Universal" Method of Converting Street Lamps to the Inverted System.

To supply large units of light for interior illumination, the "Trilux" lamp has been devised. This, as its name signifies, has three burners; these being of the angle type. Each burner has an adjustable gas-injector and the bye-pass lever cock is of the flashing order. The brass parts have been strongly made; and the enamelled smoke and heat disperser and reflector are finished white inside and buff colour outside. The air ports to the bunsen burner are protected from dust and insects by a gauze covering; and what by many is considered a noteworthy feature and distinct advantage in the lamp is the large enamelled heat and smoke disperser at the top, which effectually obviates the blackening of ceilings.

INVESTIGATION OF GASEOUS EXPLOSIONS,

WITH SPECIAL REFERENCE TO TEMPERATURE.

A British Association Report.

At the recent meeting of the British Association in Dublin, an important report was presented by the Committee appointed to investigate the subject of gaseous explosions. The Chairman of the Committee was Sir W. H. Preece, and the Joint Secretaries were Mr. Dugald Clerk and Professor Bertram Hopkinson. The other members of the Committee included Professor Burstall, Dr. Harold B. Dixon, and Professor Arthur Smithells. As an appendix to the report, Professor Callendar contributed a learned disquisition on "The Deviation of Actual Gases from the Ideal State, and on Experimental Errors in the Determination of their Specific Heats." To-day we give the first portion of the main report, which starts with an indication of its general scope—stating that to engineers the investigation of gaseous explosions is chiefly of interest because of its bearing upon the theory of the internal combustion engine.

The essential feature common to the operation of all gas-engines, the Committee proceed, is the conversion of a mixture of inflammable gases, by combustion or explosion, into a mass which consists in all practical cases of a mixture of steam, carbon dioxide, nitrogen, and excess oxygen. The performance of the engine depends primarily on the change in pressure or volume, or both, resulting from this chemical transformation, and on the properties of the products of the transformation after they are formed. It depends in only a secondary degree on the nature of the chemical process, and on the velocity with which it takes place. These matters, important though they must be in any investigation of explosions and in the theory of the gas-engine, are not of the first importance. The foundation must be a knowledge of the properties of the gases enumerated above at the temperatures occurring in the gas-engine—that is, between 1000° and 2500° C. This report, therefore, consists mainly of an analysis of the present state of knowledge on this subject, together with suggestions as to the directions in which further research may be undertaken with the object of advancing it. It will be found, however, that as the mechanism and the velocity of combustion must be taken into account as disturbing factors when applying our knowledge of the gases in the theory of the gas-engine, so they enter into many of the experiments on which that knowledge is based; and some discussion of them is indispensable in any criticism of these experiments.

Thermodynamic theory shows that the physical properties of a gas in chemical equilibrium are completely specified when: (1) The relation between the pressure and the volume at constant

temperature is known; (2) the internal energy per unit volume is given as a function of the temperature and the density.

The energy of a gas per unit of mass at temperature θ is usually defined as $k\ (\theta - \theta_0)$, where θ_0 is the standard temperature from which energies are reckoned, and k the mean specific heat at constant volume between the temperatures θ_0 and θ. The second of these data is, therefore, equivalent to a knowledge of the specific heat in terms of the temperature and density. This form of statement is probably more familiar; but, for reasons given later on, it is in many ways less convenient that that based upon the energy function.

For those gases with which we have to deal, it may be assumed that the first relation is that given by Boyle's law. Experiment and theory alike point to the conclusion that deviation from this law only occurs when the density of the gas departs widely from its normal value, and that it is diminished by high temperature. In the gas-engine the density of the gas rarely exceeds ten times that of the atmosphere, a point at which the deviation from Boyle's law in air (at 100° C.) is only about $\frac{1}{2}$ per cent.

It is usual to make the further assumption that the product pv is proportional to the absolute temperature θ. A detailed examination of the grounds of this assumption forms the subject of a section of this report. At this point it is only necessary to notice that, if it be true, then the internal energy is a function of the temperature only, and is independent of the density. If, on the other hand, the perfect gas-law does not hold, then the true relation between pv and θ can be deduced from a knowledge of the internal energy, which is in that case a function both of the temperature and of the density.

The properties of the gases with which we have to deal are, therefore, completely defined when the energy has been tabulated as a function of the temperature and the density. So far as the present state of knowledge goes, the energy is to be expressed in terms of temperature only; but an important part of future investigation must deal with its dependence on the density either by direct measurement or by a determination of the relation between pv and θ at high temperatures.

The prediction of the temperature reached in combustion, which must be the starting point of any investigation of explosions, also rests primarily upon a knowledge of the energy function. For, subject to corrections for loss of heat, incomplete combustion, and work done while combustion proceeds, the thermal energy of the mixture of steam, CO_2, &c., after combustion is equal to the chemical energy of the gases from which the mixture was formed. The latter can be accurately inferred from the composition of the combustible gases; and, the thermal energy being thus known, the temperature can be calculated from a table of the energy function. The pressure or volume changes resulting from combustion can be deduced from the temperature by the use of the p—v—θ relations, which again ultimately depend upon the form of the energy function. A table of this function at high temperatures is, therefore, the first datum necessary for the investigations entrusted to the Committee, and is the principal subject of this report. Before proceeding to the discussion of this physical question, however, it is well to say something further about its bearing on practical engineering problems.

The first requisite for predicting the performance of a gas-engine is to know the rise of temperature and the consequent rise of pressure produced by the explosion. The importance of this need not be insisted upon. It is not only the principal factor in the mean pressure developed, it also determines in large measure the mechanical design of the engine and the necessary strength of its parts. The part played by the energy function in the calculation of this rise of pressure has been indicated in the last paragraph. In proceeding further to analyze the indicator diagram given by the engine with the object of accounting at each point for the heat which has been put in, a knowledge of this function is again required. The heat accounted for on the diagram is the work which has been done *plus* the heat contained in the gas. The latter item can be calculated from the temperature if the energy function be known. The balance unaccounted for, which it is usually the object of such investigations to find (whether in the steam-engine or the gas-engine), is the heat which has been lost to the walls, or has been suppressed owing to incomplete combustion. In fact, the internal energy of the gases at high temperatures plays much the same part in the analysis of gas-engine phenomena as does the total heat of steam in investigating the working of the steam-engine.

Again, from a table of internal energy, it is possible to predict the pressure changes resulting from any series of operations such as occur in the gas-engine, one item in which is an explosion subject to certain hypothetical conditions which cannot be realized in practice, though they can be indefinitely approached. An ideal diagram of this kind, corresponding to the cycle of operations which is most usual in present-day gas-engines, can (for example) be constructed for any given combustible mixture on the assumption that the combustion is instantaneous and complete at the in-centre; that there is no loss of heat in compression, explosion, or expansion; and that during expansion the gases are at all times in thermal and chemical equilibrium. These conditions can never be completely realized, but can in theory be approached asymptotically by improvements in design carried on within certain defined limits—namely, that the degree of compression and the nature of the mixture are to be unaltered. For example, the heat loss may be reduced by increasing the size of the engine and altering the nature of the cylinder walls; and the attainment of thermal and chemical equilibrium may be promoted by reducing the speed. Such an ideal cycle is, in fact, precisely analogous to the Rankine cycle of the steam-engine, in that it takes account of the actual physical properties of the working substance, but leaves out of account such non-essential imperfections as heat loss to the cylinder walls. It represents an ideal which the real engine may approach indefinitely but can never attain; and the closeness of the approach is a true measure of the perfection of the engine.

The ideal cycle which has hitherto been used in discussing the performances of gas-engines is the well-known air-cycle. This is based upon a special assumption as to the form of the energy function—namely, that it is a linear function of the temperature at high, as it is known to be at low, temperatures. The specific heat of the working substance is taken to be constant and equal to 19 foot-pounds per cubic foot, or 4·8 calories per gramme molecule. In the state of ignorance as to the real form of the energy function which prevailed until quite recently, this assumption was as good as any other, since it was impossible to say that the value of the energy derived from it was further from the truth than any other value which might be assigned to it. So far as was known, the differences between the indicator diagram of a real engine and the corresponding air-cycle diagram might have been wholly, or almost wholly, due to what have been called above "non-essential imperfections"—that is, to heat loss and to incomplete combustion. In other words, there was no conclusive evidence that the air-cycle was not for practical purposes a true ideal cycle in the sense defined above, and equivalent to the Rankine cycle for the steam-engine. Under these circumstances its extreme simplicity made it the best available standard of comparison for judging the performance of a real engine. Recent researches, however, on the properties of the gases at high temperatures have definitely shown that the assumption of constant specific heat is erroneous, and have given sufficient information about the magnitude of the error to show that it is of material importance. They have shown that the air-cycle cannot be regarded as equivalent to the Rankine cycle in the steam-engine, inasmuch as it does not take account of the properties of the actual working fluid, but postulates a hypothetical fluid which has no real existence. It is as though in the theory of the steam-engine the total heat of the steam were to be taken as equal to its latent heat—the sensible heat of the water being neglected. This assumption would lead to a simpler formula for the ideal efficiency for the steam-engine, but it would be erroneous in the same way and to about the same extent as the air-cycle formula for the gas-engine.* The closer approximation to the real cycle which is made by taking account of the actual properties of the working fluid—in the steam-engine the total heat of the steam instead of only the latent heat; in the gas-engine, the true value of the energy instead of that based on the assumption of constant specific heat—though it leads to some complication of formulæ, gives compensating advantages of real practical value. It shows the engineer what are the limits to the improvements which can be effected by changes of design or increase of size; and it enables him to judge whether it is better that the lines of development should proceed in such directions or in the direction of radically modifying the cycle of operations.

Measurement of the Internal Energy or Specific Heats of Gases at High Temperatures.

The results of most experiments on the energy of gases have been expressed in the form of tables or formulæ giving the specific heat (referred to unit mass of the gas) in terms of the temperature. It would appear preferable for most purposes to exhibit them in terms of internal energy per unit volume. This is the form most convenient for purposes of thermodynamic calculation; and it has the further advantage that it expresses the actual quantity measured. In nearly all the experiments on the specific heats of gases, the increase of energy in unit volume associated with a large rise of temperature is measured; and in most the lower limit of temperature is near that of the room. The rate of change with temperature, of the energy so determined, is sometimes called the "true" or "instantaneous" specific heat, and sometimes "thermal capacity." The Committee are of opinion that a definite name should be given to this important quantity; and they suggest the name "volumetric heat," which, if adopted, should include in its significance that the measurement to which it relates is made at constant volume, and is referred to unit volume of the gas. The term "specific heat" could then be restricted to its usual meaning, which refers to unit mass of the substance. Convenience of calculation is promoted if the unit of volume taken is that corresponding to the gramme molecule under standard conditions which is sufficiently nearly the same for each of the gases under consideration and equal to 22·25 litres.† In this report, internal

* If the sensible heat of the steam can be neglected in comparison with its latent heat the Rankine cycle reduced to the Carnot cycle with efficiency $\frac{T_1 - T_2}{T_1}$, for no heat is then necessary to warm the water from the condenser to the boiler temperature; and the whole process becomes reversible. The efficiency of the Carnot cycle usually exceeds that of the corresponding Rankine cycle by about one-eighth part.

† The volumes of the gramme molecule for the several gases are—

H_2	22·24	CO	22·21
N_2	22·28	CO_2	22·08
O_2	22·22		

in litres at 0° C. and under a pressure of 760 mm. of mercury. It may be noted here that 1 calorie per gramme molecule is equivalent to 3·96 foot-pounds per cubic foot.

energy and volumetric heat are expressed as calories * per 22·25 standard litres; and the zero of temperature from which the energy is reckoned (except where otherwise stated) is taken to be 100° C., in order that steam may be included on the same basis as the other gases. The results are conveniently exhibited as curves in which the energy is the ordinate, and the excess of the temperature over 100° C. is the abscissa. The slope of such a curve represents the volumetric heat C., and the ordinate divided by the abscissa for any temperature represents the mean volumetric heat from 100° C. to that temperature, here denoted by $\overline{C}$.

The experimental work done upon this subject may be divided into three classes: (1) Constant-pressure experiments: Regnault, Wiedemann, Witkowski, Lussana, Holborn and Austin, Holborn and Henning. The gas is heated from an external source in these experiments, and is at atmospheric pressure. (2) Experiments in which both volume and pressure are varied; the gas being heated by compression. The recent experiments of Clerk, and the determinations of the velocity of sound in hot gas by Dixon and others, belong to this class. (3) Constant-volume experiment. To this category belong the explosion experiments of Mallard and Le Chatelier, Clerk, Langen, Petavel, Hopkinson, and others, and Joly's determinations with the steam calorimeter. In the explosion experiments the gas is heated by internal combustion.

Constant-Pressure Experiments.

The constant-pressure experiments have been carried to a temperature of about 1400° C. The gas under atmospheric pressure flows steadily through a heater and then through a calorimeter, where it is cooled. The temperature just before entering and just after leaving the calorimeter, and the quantity of heat evolved per gramme molecule of the gas, are measured. This quantity of heat, less the work done in the contraction, which is 1·98 times the fall of temperature, is the change of internal energy corresponding to that fall.

Regnault applied the method to air, H_2, CO, CO_2, and other gases over the range 0° to 200° C. Wiedemann repeated Regnault's experiments with some modifications of the apparatus. On account of the small range of temperature, these experiments must be regarded as only giving the slope of the internal energy curve at the origin; but as they give this with an accuracy at least equal to that with which the ordinate is known at higher temperatures, they are of considerable importance in constructing the curve. The following table shows the values of the mean volumetric heat C. over the range 0° to 100° C., found by these two observers for air, H, and CO. Witkowski's value for air, by the same method, is in exact agreement with Regnault's—

	H_2.	CO.	Air.
Wiedemann . . .	4·84 ..	4·81 ..	4·90
Regnault	4·84 ..	4·88 ..	4·86

These results give a good idea of the accuracy attained in these experiments. In both sets the different observations ranged about 1½ per cent. above and below the mean in each determination. Later work shows that the value of $\overline{C}$ for air is probably about 1 per cent. greater over the range 0 to 200 than over the range 0 to 100. Regnault was unable to detect this difference, though he looked for it.

The volumetric heat of air has also been determined by Joly by means of the steam calorimeter. He found the specific heat of air at constant volume for the range 10° to 100° C., and at a pressure of about twenty atmospheres, to be 0·172. There were distinct signs of an increase of specific heat with density; and assuming this to follow the linear law given by Joly, the specific heat at normal density would be 0·1715—equivalent to 4·93 calories per gramme molecule. Professor Callendar points out, however, that this is based upon Regnault's number for the latent heat of steam which is of doubtful accuracy, and that more probably Joly's determination when reduced to the 15° calorie should be 0·1732, or 4·98 calories per gramme molecule. According to some unpublished experiments by a constant-pressure method (which have been made by Mr. Swann in Professor Callendar's laboratory, and in which it is believed that some sources of systematic error inherent in the earlier experiments of this type have been avoided), the volumetric heat of air is 5. These results are distinctly higher than those obtained by Wiedemann and Regnault; but the difference is of no importance for the present purpose except as an indication of the possibility of systematic errors in their method of experiment which may become important when it is applied to higher temperatures. It may be taken as fairly certain that the volumetric heat of air at 100° C. is within 2 per cent. of 4·9.

In the case of CO_2, the results obtained by Wiedemann and Regnault were—

		W.	R.
Increase of internal energy . . .	0 to 100 ..	710 ..	680
,, ,, ,, ,, . . .	0 to 200 ..	1510 ..	1490
,, ,, ,, ,, . . .	100 to 200 ..	800 ..	810

The first two rows of figures represent practically the quantities actually measured in these experiments.* The third is obtained by difference from the first two; and it is therefore affected with a greater probable error than either. The result of the two sets of experiments may be summed up by saying that the volumetric heat of CO_2 at 100° C., taken as equal to the mean volumetric heat between 0° and 200° C., is between 7·45 and 7·55, and that its rate of increase with temperature is between 0·009 and 0·013, or, roughly, one six-hundredth part per degree C. The specific heat of steam at constant (atmospheric) pressure in the neighbourhood of 100° C., according to Regnault, is 0·48, equivalent to 6·64 volumetric heat; and subsequent observers have shown that this value is at least as accurate as Regnault's value of the specific heat of air.

From Joly's experiments with the steam calorimeter, when corrected according to Callendar for the error in Regnault's value of the latent heat of steam, the specific heat of CO_2 between 10 and 100° C. and at a pressure of twelve atmospheres is 0·172; and it increases by about 0·25 per cent. per atmosphere. Assuming this law of increase to hold between one atmosphere and twelve atmospheres, the mean specific heat at normal density for the range 10° to 100° should be 0·1666; and the volumetric heat should be 7·3, which is again decidedly greater than the values obtained by Wiedemann and Regnault. According to a recent determination by Swann (the result of which has been communicated to the Committee by Professor Callendar), the volumetric heat of CO_2 at 100° is 7·76—again materially higher than Regnault and Wiedemann (7·5).

Holborn in conjunction with Austin carried the constant-pressure determinations for air and CO_2 up to 800° C. The gas was heated electrically, and the temperature was measured with a thermocouple. Similar measurements on steam were made by Holborn and Henning, who subsequently carried the determinations for the three gases up to 1400° C.

Holborn and Henning express the results of all these experiments in algebraical formula representing the mean specific heats of CO_2, air, and steam respectively over the range 0–θ in the case of the first two gases, and 100–θ in the case of steam. From these formulæ the full-lined curves in fig. 1, exhibiting the internal

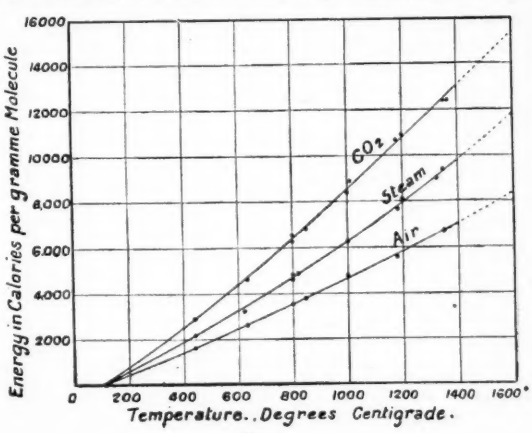


Fig. 1.

energy, have been constructed. The actual observations are also shown in the same figure. Each of these observations represents the mean of a large number of experiments—in some cases as many as thirty. The results of the individual experiments in such a group ranged about 2 or 3 per cent. above and below the mean. These casual errors would no doubt cancel out to a great extent in taking the mean, which, apart from systematic errors inherent in the method of experiment, is probably correct within about 2 per cent.

This degree of accuracy is not sufficient to enable any deduction to be made as to the manner of variation of the volumetric heat beyond a rough estimate of its average rate of increase over the whole range of experiment. The following are the values of the volumetric heats of air, steam, and CO_2 at 100°, 600°, and 1100° respectively:—

—	100°		600°		1100°		Increase 100–1100
	C	γ	C	γ	C	γ	—
Air . . .	4·9	1·404	5·2	1·38	5·75	1·345	0·9
Steam . .	6·6	1·30	6·85	1·29	8·5	1·24	1·9
Co_2 . . .	7·5	1·26	9·95	1·20	11·1	1·18	3·6

The corresponding values of γ are also shown: $\gamma = 1 + \frac{1·98}{C.}$

* There is some difference in the energy value of the calorie according to the temperature at which it is measured. The difference between the maximum and minimum value over the range 0° to 100° C. amounts to about 1 per cent. This is of no importance for the purposes of this report, except in one or two places. But where it is necessary to be so precise, the calorie at 15° C.—namely, the quantity of heat required to warm 1 gramme of water from 14½° to 15½° C.—is meant.

* The lower limit of temperature in Regnault's measurements was 10°; the upper limits were 100° and 210° respectively. In Wiedemann's work the lower limit was 25° and the upper 100° and 200° respectively. The results have been reduced to the forms here given on the supposition that the volumetric heat between 0° and 25° is 6·6, and at 200° 7·4. For the small additional range of temperature required, these figures are certainly as accurate as the experiments.

The values at 100° C. are derived from the experiments of Wiedemann and Regnault. Those at 600° and 1100° are based on the specific heat values given by Holborn and Henning. In other words, they are obtained by drawing tangents to the curves in fig. 1. The error at these higher temperatures may be double that of the internal energy, or (say) 4 per cent. The figures show that the volumetric heat of air increases by about 0·0009, that of steam by 0·0033, and that of CO_2 by 0·0036 per degree Centigrade over the range 100° to 1100° C. There is no evidence that the rate of increase is other than constant in the case of air; but there can be no doubt that the average rate of increase between 100° and 1100° in CO_2 is less than half the rate of increase between 0° and 200°, as determined by Wiedemann and Regnault. There is also distinct evidence in these and other experiments that the rate of increase of the specific heat of steam becomes greater as the temperature rises.

Clerk's Experiments.

These cover about the same range of temperature as Holborn and Henning. The gas used was the product of an explosion in a gas-engine, and therefore consisted of a mixture of CO_2, steam, and air. It was first expanded in the ordinary course after the explosion, and was then heated by compression on the next in-stroke of the engine—the valves being kept closed for this purpose. On the next out-stroke, the gas was again expanded, then compressed again, and so on; the valves remaining closed, and the engine running on its own momentum. An indicator diagram was taken of the whole operation. The change of internal energy in any portion of a compression stroke (*e.g.*, B C in fig. 2) is equal to the work done *minus* the heat lost to the cylinder walls; in an expansion stroke (C D), it is the work done *plus* the heat lost. The work can be obtained from the indicator diagram with an accuracy which is only limited by the indicating appliances. The change of temperature can also be calculated from the indicator diagram, subject to a knowledge of the temperature at one point. Errors in the latter, however, do not greatly affect the results found for internal energy or volumetric heat, because the figure for the quantity of gas present is affected by these errors in such a way as to cancel-out the error in temperature interval.

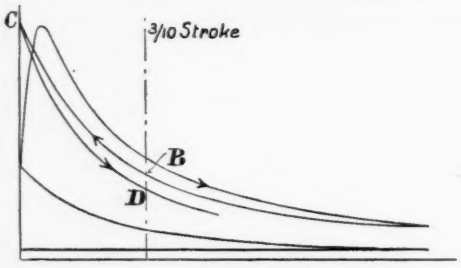


Fig. 2.

The loss of heat comes in as a correction on the work done, and was estimated by a comparison of the compression line and the immediately following expansion line (B C and C D, fig. 2). The calculation is based on the assumption that the total heat loss from the hot gases during any given portion of a stroke is the same in expansion and compression if the mean temperature be the same.

In the first compression the temperature of the gas rose to about 1100° C. (at the point C, fig. 2). During the first three-tenths of the following expansion stroke (C D), the temperature fell to about 700° C. The work done in this part of the expansion was measured and the heat loss (determined as above) was added. Thus the change of internal energy corresponding to the temperature change 1100°-700° C. is obtained. The average volumetric heat over this range is within the errors of experiment equal to the volumetric heat at the mean temperature of 900° C., which accordingly is by this method determined direct instead of by difference, as is necessarily the case when (as in Holborn and Henning's experiments) the whole internal energy change associated with complete cooling of the gas is measured.

In view of the great difference in the method of experiment, a comparison of Clerk's results with those of Messrs. Holborn and Henning is of great interest. Clerk's measurements extended to 1450° C.; but those above 1200° C. were based on the first expansion line after the explosion, when the method for getting heat loss would be of doubtful application, and when, moreover, combustion may have been incomplete. It will be better, therefore, to confine the comparison to temperatures of 1200° C. and below. The following table exhibits the internal energies of the mixed gas with which Clerk experimented, calculated from Holborn and Henning's figures, together with the energy calculated from Clerk's values for the mean volumetric heat. The energies are, as usual, reckoned from 100° C.; and the energies of an ideal gas with a constant volumetric heat of 4·9 are added for comparison.

Temperature.	Holborn and Henning.	Clerk.	Ideal Gas.
400 ..	1580 ..	1720 ..	1470
800 ..	3840 ..	4300 ..	3430
1200 ..	6285 ..	7040 ..	5390

It will be seen that Clerk's results are throughout about 10 per cent. higher than the others. The difference between the energy of the real and of the ideal gas, the discovery of which is the true object of these experiments, is about twice as great in the one case as in the other. It does not seem possible to account for so large a discrepancy by ordinary experimental errors. It must be due either to some systematic error inherent in the method of experiment in one or both cases, or to a difference in the conditions of experiment giving rise to a real difference of internal energy.

Professor Callendar has favoured the Committee with a note dealing with the constant-pressure experiments. He is of opinion that the results obtained by Regnault's method are too low, and that at the higher temperatures reached by Holborn and Henning the error may possibly amount to as much as 10 per cent. In all these experiments there is a considerable flow of heat from the heater to the calorimeter. This, of course, has to be deducted from the heat registered in the calorimeter in order to find that which has been given up by the hot gas. All the experimenters by this method have determined the amount of this correction by observations when the gas was not flowing, or have compensated it under the same conditions by radiation from the calorimeter—making, in either case, the assumption that the amount of heat conducted is the same whether the gas be flowing or not. Professor Callendar is of opinion that this heat-flow is, in fact, much less when the gas is flowing. He considers that even the values obtained by Regnault may be as much as 2 or 3 per cent. too low, and he supports this contention by reference to the work of other experimenters (some of which has been alluded to above) and by theoretical considerations. As this type of error is likely to increase greatly with rise of temperature, a systematic error of even 2 per cent. in Regnault's results, if established, would give reason to suspect that the experiments at high temperatures may be subject to errors of real importance for present purposes.

If there be systematic error in Mr. Clerk's work, it seems most likely that it lies in the estimate of heat-loss. The total heat-loss in the first partial compression and expansion line in the diagram (B C D, fig. 2) is estimated from the fall of temperature and from the net work done (area B C D) in the double operation, and amounts to, roughly, one-half the work done in expansion. This loss has to be divided between compression and expansion; and Mr. Clerk divides it on the assumption that if the mean temperature in compression and expansion were the same the heat-loss would also be the same. The mean temperature in expansion is, in fact, rather less than in compression; and the heat-loss calculated in this way is correspondingly smaller. But the difference on this account is not very great; and the result is, roughly speaking, that the loss is equally divided between the two operations. Thus the correction to be added to the work done in expansion, in order to get the total loss of energy of the gas, is about 25 per cent. of the work, or 20 per cent. of the energy change.

Professor Hopkinson has dealt with this point in a note which he communicated to the Committee; and he is of opinion that, relative to the mean temperature, the heat-loss is really much greater in compression than it is in expansion. He supports this view by reference to some experiments which he has made on the compression and expansion of a charge of cold air in a gas-engine which was motored round with the gas cut off. The specific heat of air being known, the loss of heat in any part of the compression or expansion stroke can in this case be independently estimated from the diagram. He found that while in the latter half of the compression stroke the heat lost to the walls amounted to a considerable fraction of the work done, some part of this loss was actually restored to the gas during the first half of the succeeding expansion, and this notwithstanding the high temperature of the air, which in expansion, as in compression, was much above that of the walls. An estimate of the thermal capacity could, of course, be obtained from the diagram by the application of Mr. Clerk's method; and it would lead to a result considerably in excess of the truth. Mr. Clerk has himself tried this same experiment of compressing and expanding air, and he has also found that the resulting value of the specific heat of air is too high and that the air takes in heat during expansion. Professor Hopkinson thinks it possible that the heat lost during the partial compression line in Clerk's diagram may be more than twice as great as the loss during expansion. If this were so, the correction for heat-loss in expansion would be less than 16 per cent. of the work done, instead of 25 per cent., and the true change of energy would be less than that calculated on the assumption of equal heat-loss in compression and expansion by 7 per cent. or more.

It will be seen that the errors believed to affect each method of experiment are in such a direction as to account for the divergence of the results; and it is quite probable that when these errors are completely allowed for, the discrepancy will largely disapp ar. Meanwhile, the internal energy of the products of combustion in the gas-engine at 1200° C., if taken as the mean of Clerk's and of Holborn and Henning's results, must be regarded as subject to a possible error of about 5 per cent.

Under these circumstances, it does not seem necessary to discuss the possibility that there may be a real difference between the energy values obtained by the two methods due to the different conditions of experiment. It may be pointed out, however, that Clerk's gas was at the maximum temperature from fifteen to twenty times as dense as Holborn and Henning's. The difference in the condition of the gas is such that a comparison of the results obtained by the two methods, when freed from experimental errors, will be of great interest and importance.

(To be continued.)

SOME BRITISH ASSOCIATION PAPERS.

Peat Gas—Producer Gas—Suction Gas.

On Monday of last week, at the Dublin Meeting of the British Association, three papers in which "JOURNAL" readers are particularly interested were read and discussed together. The author of the first, entitled "The Utilization of Peat for Making Gas or Charcoal," was Captain H. Riall Sankey, R.E. Mr. J. Emerson Dowson, M.Inst.C.E., contributed the second, on "Producer Gas." Mr. P. W. Robson, of the National Gas-Engine Company, read the third paper, discussing "Suction-Gas Producers." We give extracts from all three communications.

UTILIZATION OF PEAT.

"The Utilization of Peat for Making Gas or Charcoal, with Recovery of Bye-Products," was the full title of the paper contributed by Captain H. Riall Sankey; and the following is an outline of the communication.

The much-discussed subject of the utilization of peat has during the last few years been revived owing to developments in gas-producers and in gas-engines. At the moment it is of considerable interest in Ireland in connection with the Bill which was promoted in Parliament early in the session to obtain powers to produce gas from peat, to use this gas for making electricity by means of gas-engines and dynamos, and to distribute electric power to works which will probably be established in the immediate neighbourhood of the power station and throughout a certain prescribed district. It is proposed to put the power station alongside the Grand Canal, not far from Robertstown, about 25 miles from Dublin.

Previous attempts to utilize peat for power failed because they were based on drying the peat, so as to contain no more than 25 per cent. of water; and in some cases the expense of "briquetting" was incurred. The peat was then transported to the place where power was required, and was burnt in steam-boilers fitted with specially-designed furnaces. Such peat could not compete with coal; moreover, the valuable bye-products were not recovered. In the proposed scheme, the peat will only be partially dried—that is to say, it will still contain 60 per cent. of water. It will be used on the spot to make gas, so as to get the benefit of the great thermal efficiency of gas-engines and save the cost of carriage. The bye-products will be recovered, and the profit on them will at least cover the cost of getting and drying the peat. According to the author, it will be possible to supply power to works in the immediate neighbourhood of the power station as cheaply as can be done from water power; and it is believed that many of the industries which are dependent upon cheap power will be attracted.

There are several methods of getting and drying peat. Apparently the most suitable, when it is desired to obtain peat nearly all the year round, is to dig with a grab, and pass the peat through a Dornberg press. The peat then rapidly dries to 60 per cent., except in very wet weather in the winter; and to tide over this period, a reserve of peat must be accumulated. The producers employed for making gas from peat are similar to those used with bituminous coal; but they are larger in dimensions for the same power. The gas issuing from the producers passes through the recovery plant, and thence to the gas-engines. In passing through the recovery plant the gas is cleaned in a perfect manner, and therefore troubles due to tar and dust are entirely obviated.

The bye-products which can be obtained from peat are somewhat numerous; but at the moment, when gas is made, sulphate of ammonia is the only one which has been treated on commercial lines. It is estimated that, when combined with an electric power undertaking, the net profit on the sulphate is about 4s. per ton, which more than covers the cost of peat—viz., 3s. per ton.

The profit on the other bye-products cannot yet be credited, because up to the present these bye-products have only been obtained commercially when making peat charcoal (Ziegler process); and it is possible that when making gas some initial difficulties may be met with in obtaining them on a commercial scale. There is no reason to doubt, however, that eventually they will be satisfactorily worked. In particular, there appears to be no reason why the waggon grease (referred to later in describing the Beuerberg works) should not be readily obtained when making gas; and the annual output would be about 3000 tons, with the proposed producer capacity of 65,000 tons of theoretically dry peat per annum.

The amount of sulphate of ammonia obtainable depends on the quantity of nitrogen in the peat. It is easy to show that theoretically the maximum yield of sulphate is $132 \div 28$ times the nitrogen present. An analysis made by Professor Watson Gray gave 1·6 per cent. as the average amount of nitrogen present in the samples taken from the Bog of Allan; and this percentage agrees substantially with other published results. In this case, the theoretical yield per ton of dry peat would be 170 lbs.; but according to some trials made at Openshaw by Messrs. Crossley Bros., the actual yield, with peat containing 2·2 per cent. of nitrogen, was 140 lbs. per ton of dry peat, and the proportionate yield for 1·6 per cent. of nitrogen is 102 lbs., which, it will be seen, is 60 per cent. of the theoretical yield. The capacity of the producers for the power scheme under consideration being 65,000 tons of dry peat per annum, the yield of sulphate would, in round figures, be 3000 tons per annum. Great care must, however, be taken in selecting the bog, since some analyses show as little as 1 per cent. of nitrogen.

The other important bye-products are acetate of lime, methyl alcohol, and tar containing paraffin wax and oils. Excellent waggon grease can be made from the tar, the output of which at Robertstown ought to be about 2000 barrels per annum. The monetary value of these bye-products will, it is calculated, be about equal to that of the sulphate of ammonia. Instead of gas, an excellent charcoal can be made from peat, together with the bye-products enumerated above. The process has been in operation near Oldenberg for upwards of ten years. The most up-to-date factory, however, is at Beuerberg, near Munich, and it has been at work for three years. The charcoal obtained from peat is said to be of excellent quality, and can be used to advantage to replace wood charcoal. It is employed in large quantities in Germany in connection with the manufacture of steel.

In view of the difficulties which have arisen in the use of gas-engines of large size in certain electric power undertakings, doubts may be expressed as to their suitability in this case. When the matter is analyzed, however, the author points out, it will be found that very nearly all the troubles have occurred either with very large gas-engines, or when using producers burning bituminous coal. In reality, there is little saving in capital cost, and none in annual cost, in using very large gas-engines. As regards capital cost, the price asked for very large gas-engines is practically the same as it is for moderate-sized engines, and there is something saved on the foundations; but the buildings are more costly. In the matter of annual cost, gas-engines, unlike steam-engines, have nearly the same heat efficiency in small sizes as they have in large, and numerous trials show that gas-engines even as small as 50-horse power attain to within 88 per cent. of the theoretical thermodynamic possibilities. It would, therefore, be practically impossible for even the largest gas-engines to improve upon this by more than 1 or 2 per cent. In an electric power station, moreover, smaller units will be found to be more economical, because when very large units are employed, it is more difficult to adjust the number of engines running to the requirements of the moment—that is to say, with large gas-engines it is not possible to load-up the engines running to approximately full load; and, as is well known, the economy falls off rapidly when the engines are not fully loaded.

PRODUCER GAS.

The paper on this subject was submitted by Mr. J. Emerson Dowson, M.Inst.C.E. The author's first paper was read at the York meeting of the Association in 1881, and, after twenty-seven years, he reviewed briefly the progress since made. In large furnace work he traced the developments and improvements in the system introduced by Messrs. Siemens. He said its success had been great, and had been due chiefly to heating the air for combustion by the waste products. Dr. Mond's system for the recovery of sulphate of ammonia, which reduces the cost of fuel, was also mentioned. For smaller heating work, where jets of gas are required, it is essential that the gas should be clean, of good quality, and of uniform pressure. This is especially necessary where the gas must be burnt with air at pressure, as for blowpipes, &c. Having enumerated the various purposes for which producer gas is used, the author said he considered that, in proportion to the immense amount of heating required in the various industries throughout the kingdom, greater progress would have been made if manufacturers and others had known more about the subject technically. Often they did not seem to understand the treatment of gas, or what could be done with it. Undoubtedly, the greatest development in the use of producer gas had been with gas-engines; one having been worked for the first time with producer gas in 1879, in a plant devised by the author. The calorific power of the gas was the same now as then; but less gas was consumed per horse power, owing to improvements made in the engines.

The author explained the meaning of pressure and suction gas, and then went on to say that in 1862 Dr. Jacques Arbos, of Barcelona, patented a gas-producer worked by the suction of an engine; but the first to deal with this in a practical way was M. Léon Bénier, of Paris, in 1891. But modifications and improvements have since been made, and the suction plant is extensively used. The chemical reactions on which pressure and suction gases depend are identical; but the calorific power of pressure gas made with a jet of superheated steam is usually considerably higher than that of suction gas. For heating purposes in small burners or in blowpipes, pressure gas is better; and an engine worked by suction gas develops a rather lower maximum power than with pressure gas.

In considering the two types of plant for engine work, the author's general conclusions were: A suction plant costs less and occupies less ground space; but the gas made in it is not so strong as in the older form of pressure plant, and in some cases this is important. The fuel consumption per horse-power-hour and the labour are the same in both types of plant, provided the steam required for the pressure gas is raised without an independent boiler. The consumption of water is the same in both types. Where there are several engines to serve, the gas-piping is simplified and its cost reduced when the gas is taken from a small gasholder instead of from several suction plants. In some cases

the pressure type is better than the suction; whereas in others suction is better than pressure. From the economical point of view, where producer gas is used instead of ordinary town gas for heating work, there is usually a saving of 50 to 60 per cent. With engines the consumption of anthracite is guaranteed not to exceed 1 lb. per brake-horse-power-hour (under full or three-quarter loads) in both types of plant. Gas coke is also used; but its consumption is a little higher. For large furnace work, non-caking bituminous coal is almost invariably employed; and in some cases this kind of coal is also used for engine work.

Suction Gas Plants.

The paper by Mr. P. W. Robson, entitled "The Production of Cheap Power by Suction-Gas Plants," proved to be of an exceptionally interesting character; and this will justify some lengthy extracts being given.

The author pointed out that in the two years which have intervened since Professor Dalby first described the suction-gas producer before the Association, the demand for such apparatus has shown a steady and continuous growth both in this country and abroad. It is safe to say that in the great majority of cases experience in the actual working of combinations of gas-engines and suction producers has given the utmost satisfaction to the user. They have proved to be both convenient and reliable as a means of deriving cheap power; and there are good reasons for believing that as the possibilities of the system become more fully understood its application will be increasingly extended.

It is interesting to note that though the idea of working producers on the suction principle was first suggested in France by M. Benier, and afterwards continued to a comparatively small extent in Germany, the real development of suction producers on a large commercial scale only took place when British engineers devoted themselves to their design and manufacture; and the extent to which trade in them has increased during the last four years is remarkable.

There are several reasons for this, the chief of which undoubtedly is that the modern gas-engine and suction producer can, in fact, give power to small users and to large users for factory and electric driving more cheaply than it can possibly be obtained by other means. To illustrate this, the author selected three typical cases where the load demand and general requirements are widely different. In each case the figures given represent average ascertained costs over at least a twelve months' period of working.

Ascertained Total Power Costs with "National" Gas-Engines.

—	Case A. Cement Works.	Case B. Weaving Shed.	Case C. Small Factory.
Size of installation in brake-horse-power	450	300	20
Average working load, brake-horse-power	360	220	7·8
Total brake-horse-power-hours per annum	2,726,000	610,500	21,200
Initial total cost of installation (including foundations)	£4230	£2640	£250
Total annual charges:—	£ s. d.	£ s. d.	£ s. d.
Interest and depreciation	423 0 0	264 0 0	25 0 0
Repairs and sundries	50 0 0	30 0 0	3 10 0
Fuel	1298 4 8	135 4 2	15 11 0
Oil	135 3 10	10 0 0	2 0 0
Water (taken from canal in cases A and B)	..	..	7 5 0
Attendance, &c.	423 17 4	135 0 0	12 10 0
Total	2330 5 10	574 4 2	65 16 0
Total cost per brake-horse-power-hour	0·205d.	0·225d.	0·745d.
Equivalent cost per Board of Trade unit*	0·245d.	0·27d.	0·79d.

*This means that if current were delivered from a public supply to a motor of 90 per cent efficiency in cases A and B, and a motor of 80 per cent. in case C, the rate of charges for such current would have to be those stated to give the equivalent cost per brake-horse-power-hour also mentioned above. If, however, the standing charges in respect of the motors and electrical installation generally are added, this rate would have to be greatly reduced to equal the gas-engine installation in economy.

The significance of these figures will be appreciated from the fact that, if in case A current was taken from a public supply at ½d. per unit, the total cost would be £4708 per annum. As the actual working costs with suction gas are £1907, the difference between the latter and the cost of electricity at the assumed low rate of ½d. per unit represents a saving of £2801 in favour of the gas-power installation. This saving would entirely defray the initial total cost of the latter in little over eighteen months.

Nor can it be said that this economy has been obtained at the sacrifice of reliability; for, in the weaving-shed referred to, the engine has been started up punctually every morning without fail; and the only stoppage in twelve months was that due on one occasion to a heated connecting-rod brass. In the case of the cement works, rotary kilns are being operated; and thus the engines are regularly run for periods of from six weeks to two months night and day without stoppage.

It is also important to notice how the gas-engine compares with its competitors, the electric-motor and the steam-engine, in the rate of breakdowns. Mr. Michael Longridge, in his last annual report, gives the following figures relative to engines and motors insured by his Company:—

Rates of Breakdowns.

Steam-engines	1 in 8·1
Electric-motors	1 in 8·2
Gas and oil engines	1 in 12·4

from which it would appear that, broadly speaking, gas and oil engines may be considered 50 per cent. more reliable in actual practice than steam-engines or electric-motors.

After referring to the successful development of these producers throughout the British Isles, the author proceeded to describe a typical combination of engine and producer, and continued: The conditions under which combustible gas is produced in the generator so as to give the best efficiency have been carefully investigated. Obviously, the fuel must be gasified in such a way as to lose a minimum quantity of heat in the producer; so that as large a balance as is possible is available for useful work in the engine. The only burnable gas which can be obtained in the usual way by the partial combustion of the carbon constituents of the fuel is carbon monoxide (CO), as expressed by the equation—

$$2\,C + O_2 = 2\,CO \qquad (a).$$

But the production of this gas is attended by an evolution of 30 per cent. of the heat of the carbon reacted on. Unless this heat were to a large extent recovered, the efficiency of the producer would, obviously, be very low; and besides the cumulative effect of a continual liberation of heat in this degree would be to set up a very high temperature in the producer, which would tend to the formation of excessive clinker and also cause many other difficulties.

A simple practical means of utilizing this heat and enriching the gas at the same time is by the method so generally adopted now of saturating, or partially saturating, the air passing to the furnace with steam. This steam reacts with incandescent carbon in two alternative ways:—

$$C + 2\,H_2O = CO_2 + 2\,H_2 \;(b)$$
$$C + H_2O = CO + H_2 \;(c).$$

In these two reactions a combustible gas results; and they both require heat to enable them to take place. This is supplied by the liberated heat just referred to, which results from the direct combination of the oxygen of the air with the carbon of the fuel to form carbon monoxide; and hence, broadly speaking, the degree in which the reduction of steam according to either of the foregoing equations can take place with advantage depends entirely on the amount of heat available from the production of carbon monoxide in the primary reaction according to the above equation (*a*).

The decomposition of steam in the presence of heated carbon, however, begins at a comparatively low temperature—between 500° and 600° C.; and hence if too much steam is used the fire becomes unduly cooled, which is undesirable, for reasons which will be presently considered.

A further advantage which follows from the use of steam is the enrichment of the gas made; for the hydrogen evolved by the reaction (*b*) and the monoxide and hydrogen in reaction (*c*) are combustible gases produced apart from reactions with atmospheric oxygen, which in all cases carries with it four times its volume of nitrogen. This latter is a diluent in all producer gas, and passes through the furnace unchanged. Hence the use of steam simultaneously effects three useful and necessary functions in the producer: It prevents the working temperature of the furnace from becoming excessive; in so doing, secondly, it absorbs the large proportion of heat liberated by the union of the carbon of the fuel with the oxygen of the air passing to the furnace; and, thirdly, by producing carbon monoxide and hydrogen direct, the proportion of combustibles in the gas yielded by the producer is largely increased in proportion to the amount of inert nitrogen drawn in along with the air.

By neglecting radiation losses, and also the heat losses in the scrubbers, it is possible to make a simple calculation of the conditions under which all the heat of the fuel can be accounted for in the gas produced; and such a calculation is useful in showing more clearly how a suction producer actually works.

The author went in detail into the various calculations needful to determine this point, and then proceeded: The importance of properly proportioning the steam supply will be appreciated—otherwise the best results cannot be obtained. And this is one of the points to which further attention might with advantage be given by gas-plant designers. Given a properly-designed producer, however, the conditions of highest efficiency can be automatically and continuously obtained without the slightest trouble week in and week out while the plant is being worked by an ordinary attendant.

In all suction producers directly connected to the engine, and automatically regulated thereby, successful working depends also upon the absence of any serious restriction to the flow of gas from the furnace to the engine cylinder. If for any reason there is a restriction, the weight of charge drawn into the working cylinder of the engine is reduced and a loss of power results which may make all the difference between success and failure. The very simple form of generator and scrubber in the ordinary suction plant using non-bituminous fuel makes it possible to avoid undue restriction, even when gas coke or poor anthracite is used, each of which yields a certain amount of tarry matter,

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and consequently requires the addition of a suitable tar-extractor to the scrubber. The suction pressure can be kept sufficiently low to prevent the volume of charge being unduly diminished.

Simplicity in all directions is the essential condition for successfully working any producer by the suction effect of the engine; and this being so, the difficulty of treating bituminous fuels in any simple type producer will be appreciated. Bituminous fuels contain upwards of 30 per cent. of volatile matter, which distils off at such temperatures as are found in the upper part of a suction producer, and pass away along with the gas made in the lower part of the furnace before fresh fuel reaches the active zone of combustion. Now, of these volatiles, 6 per cent. and upwards is tarry matter, which condenses out as the temperature of the gas is lowered in the scrubber and gas-mains. These latter would quickly become clogged up; and, in addition, so large a proportion of tar would be carried forward to the engine that the successful working of the latter would be vitiated. It is this tar difficulty which is the chief trouble to be dealt with in making a successful suction producer to work with bituminous fuels; for the addition of extra cleaning apparatus to extract the tar in a sufficient degree would necessarily have the effect of greatly increasing frictional resistance to the passage of the gas from the generator to the engine, and would otherwise destroy the simplicity of arrangement shown to be essential.

Much attention has naturally been turned, therefore, to various methods by which the tar trouble can be eliminated, with the hope that it might prove possible to transform the condensable tarry vapours into fixed gases in the generator, so that the difficulty of tar extraction and additional cleansing apparatus generally could not arise at all. Attempts have been made to decompose the tar by working the producer on the down-draught principle, which has the effect of compelling the volatiles to pass through the hot zone of the furnace before leaving the producer. By another plan the gas outlet is in the middle of the producer, and air is supplied both at the top and at the bottom; the action which is aimed at being to use the upper half of the producer as a down-draught furnace for distilling and fixing the volatiles, while the lower half is supplied with the residual coked fuel, and works as an ordinary up-draught furnace. It is, however, extremely doubtful whether a successful solution of the difficulty will be arrived at by either of these two methods. In pressure producers many plans for reducing the tar within the producer by passing the volatiles through the hot zone of the furnace have been carefully tried from time to time, but without any sufficient measure of practical success to warrant their permanent use with bituminous steam coal such as is available here.

The author's concluding remarks were: Reviewing the present position of suction plant combinations as a means of deriving cheap power, I think it is now generally admitted by those who have looked carefully into the matter, that the claims made in respect of their convenience, economy, and reliability are well founded. The fact that these results can be so easily obtained by apparatus of such simplicity has special significance at the present time, when the question of municipal and other public electricity supply undertakings is receiving so much attention from the point of view of the desirability or otherwise of supplying cheap power to manufacturers. It is becoming increasingly recognized by leading electrical engineers that it is exceedingly difficult, and in many cases impossible, to supply current for power purposes from central stations at rates sufficiently low to favourably compete with the cost to the consumer if he generates his own power; but as attention has recently been fully drawn to this aspect of the matter in a paper read before the Institution of Electrical Engineers by Mr. J. F. C. Snell, it is only necessary to briefly refer to it here. Mr. Snell has emphasized the present inability of most electricity undertakings to meet a large demand for power at sufficiently low rates to hold their own with users' own plants; and I understand his remedy to mean the remodelling of central power stations, the writing-down of the capital expenditure already incurred in connection with them, and the elimination of independent electricity stations in small towns in favour of a central installation supplying a group of towns.

I think that Mr. Snell (who speaks with competent knowledge of electricity undertakings generally) does well to frankly face the position; but in view of such facts relative to the economy and reliability of gas power as I have ventured to refer to, it will be conceded that there are adequate grounds for the serious doubts which some of us feel as to the wisdom of embarking on the many millions of expenditure which the general adoption of his proposals would entail. The ultimate effect of proposals like his, which are chiefly framed with the object of supplying power to factories as distinguished from general electric lighting, would be nothing more than an attempt to do for the power-user what he can carry into effect on better terms for himself by the use of gas-engines and suction-gas producers.

Another important point is that the growing tendency which exists to remove all factories out of large town areas must tend to continually increase the distribution costs of electricity supply—thus making even more remote the chances of a margin of profit on any rate which it would be to the advantage of the user to accept. On the other hand, particular location has little or no influence on the economical working of gas-producers.

So far as the British Isles are concerned, all power must be derived from coal, which is almost our only source of energy at the present time. The fundamental problem, therefore, is to utilize the heat energy of the fuel as efficiently as possible at each point of application; and when power users, both small and large, have at their hand in suction-gas plant installations a simple apparatus for so doing, which is practically as efficient as the largest central station plant, the latter is at a great disadvantage when heavy distribution charges have to be added to the cost of power production at the station.

GLOWING HELIUM AS A STANDARD OF LIGHT.

The last number received of "Engineering Record" (New York) contains some reference to what they designate as "A Novel Standard of Light"—"a body of glowing helium gas."

Our contemporary remarks: A recent bulletin of the Bureau of Standards reports a research looking to the establishment of a definite standard of light. As readers have been not infrequently reminded, no valuable commodity is in so great need of definite standards of measurement as is light. It is hard to measure at best; and while the incandescent lamp, when carefully checked, has proved an admirable custodian of standard values, a satisfactory absolute standard of reference is lacking. The one most used is the hefner lamp; but it is too small (being less than a candle power) and far too red in colour to be seriously considered as a permanent standard. Various other flames have been tried; but all are somewhat unreliable and affected in an inconvenient degree by the varying density of the air and by the water vapour and carbon dioxide which the air contains. In the paper under consideration, the author—Mr. Nutting, of the Bureau—brings forward an entirely new standard in the light emitted by a body of glowing helium gas.

Helium, it will be remembered, is an extremely light gas which produces a well-known bright line in the yellow of the solar spectrum that puzzled the astronomers for many years. Found first terrestrially in mere spectroscopic traces in the gases occluded in certain specimens of lava, it was finally found in the rare mineral cleveite, isolated and examined, and has since been discovered to be an almost infinitesimal normal component of the atmosphere. One of its many peculiarities is that it glows when electrically excited at reduced pressure with an exceptionally bright yellowish white colour, much nearer the hue of ordinary artificial illuminants than the colour given by any other permanent gas. It was next found that a capillary tube—say a couple of inches long and one-tenth of an inch in diameter—could readily be so excited as to give an extremely steady light of one or two candle power per inch of length, and that the tubes could apparently be readily duplicated, so as to give concordant results. Bringing the tube to standard condition means merely applying a definite and very easily measured electric current. The life of the helium tube is not yet determined; but there is reason to think that it can be made reasonably good, especially if it should prove feasible to make a capillary tube of quartz.

Here, then, one has a standard light which seems to be capable of ready reproduction, and which is of good colour and fairly satisfactory magnitude. With quartz tubes, the available magnitude could probably be increased to 5 or 10 candle power, which would be still better for the comparison of secondary standards. The light is entirely free from atmospheric conditions, and in steadiness leaves little to be desired. It is too early in the investigation to pass judgment on the true value of the helium tube as a standard; but it certainly looks very promising indeed, and is especially interesting on account of its novelty and simplicity. It is interesting to note that the light is not at all remarkable in point of efficiency—requiring, approximately, 4 watts per candle power, owing to the existence of some very strong invisible heat radiations. But efficiency is of small account in a standard; and if the helium tube bears out its early promise, it will prove the solution of a very troublesome problem.

Among the grants in aid of scientific research made by the General Committee of the British Association at the recent Dublin meeting, was one of £75 to the Engineering Section to continue their investigations on the subject of gaseous explosions.

The autumn meeting of the Eastern Counties Gas Association will be held at Leighton Buzzard on the 24th inst. The programme includes the address of the new President, Mr. C. F. Ruggles, and a paper by Mr. John Young, of Hull, on "Tar Distilling in Medium-Sized Gas-Works." The following day a visit will be paid to the new works of the Davis Gas-Stove Company at Luton.

Under the title of "Water: Its Origin and Use," Messrs. Alston Rivers, Limited, have just issued (price 21s. net) a book written by Mr. William Coles-Finch, the Resident Engineer of the Brompton, Chatham, Gillingham, and Rochester Water-Works Company. Mr. Coles-Finch's volume should prove a popular work on the element with which it deals. Although written by an expert, it is not a purely scientific book; it is, as the author remarks in his preface, "simply an ordinary person's interpretation of what he sees in Nature and represents his best efforts to describe the same." We shall review the book later on; meanwhile it may be remarked that it is an attractive volume, embellished by over 150 beautiful illustrations, including some Alpine scenes from photographs taken by Mrs. Aubrey le Blond, who has achieved such wide renown in this branch of art.

REGISTER OF PATENTS.

Forming Joints in Pipes or Mains.

YARROW AND CO. (BOLTON), LIMITED, and YARROW, M., of Bolton.

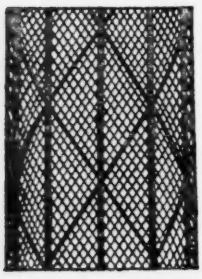
No. 19,036; Aug. 24, 1907.

This invention is supplementary to that described last week, p. 658, and refers to means for forming joints in pipes or mains. It consists in so shaping the outer or abutting ends of the pipes or mains to be jointed together that they will take within annular pieces or rings made to receive them, and in such a manner that cavities are formed between these parts for the reception of the jointing substance. This is partly inserted at the time of placing the several parts together and afterwards finally completed when these are in their respective relative positions by other jointing substances being poured therein. Provision is also made for remedying or repairing any parts of the joints which may, through one fault or another, afterwards be found defective.

Incandescent Mantles.

BERNHEIMER, J., and GUT, A., of Diessenhofen, Switzerland.

No. 19,100; Aug. 24, 1907.



This invention relates to tubular or hollow network made of ramie for incandescent mantles. An example of the construction is shown.

The network has running through it longitudinal and oblique ribs, which serve for strengthening the mantle in order to impart more resistance to it after its impregnation. It is also said that this arrangement of ribs allows of the use of less thorium in the impregnation; and that the oblique ribs increase the elasticity of the mantle, as any vibration is uniformly distributed by them over the entire network.

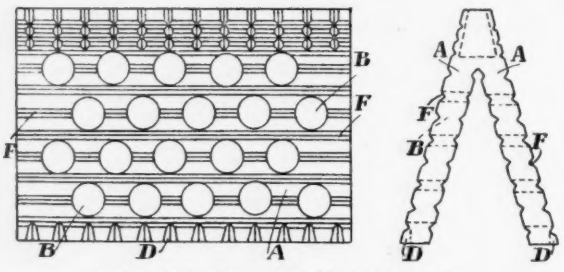
Packing Material for Gas Purifiers or Washers, &c.

PETERSEN, H., of Wilmersdorf, near Berlin.

No. 21,346; Sept. 26, 1907. Date claimed under International Convention, Sept. 27, 1906.

The packing material forming the subject of this invention is composed of perforated plates arranged at an angle with relation to each other, and either disconnected or connected to each other, so as to present a roof-shaped appearance; the top or connecting line of the plates being horizontal, as distinguished from other angular-shaped packing material.

The plates are provided with horizontal perforations in a plane parallel to the top ridge of the roof—preferably arranged at right angles to the ridge. By combining the perforations with the inclined plates, the liquid which drips down upon one of the outer sides easily flows to the inner surface of the plate, so that both the inside and outside of the plates are fully utilized, and at the same time the gases will be free to act and flow upon both surfaces of either of the plates. By the inclined position of the plates the gases must impinge against the plates and flow through the perforations and along the surfaces, "thereby becoming intimately mixed with the liquid, which, in its turn, rebounds from the inclined surfaces, and thereby becomes sprayed into minute particles, in consequence of which an intimate reaction and mixture of the spray is produced with the jets of gases emanating from the perforations—the jets being directed against each other by impinging against the inclined surfaces, so as to produce a whirling motion, thereby producing repeated subdividing and reuniting of the different particles of the gases and liquid." The ascending gases are reflected by the roof-shaped structure of the plates to a large extent, so as to rebound from one surface, and being thrown against the opposite surface and being thereby compelled to flow forth and back several times through the holes during the whirling motion imparted to them, intimate contact of the reagents and a great surface action is produced.



Petersen's Packing Material for Purifiers, &c.

One of the preferred forms of construction of the packing material is shown. A are the two inclined plates, united to each other so as to form a roof. B are the horizontal perforations of the plates; and F are the flutings on the surface. D are the downwardly-directed notches at the lower edges of the plates. The packing bodies are built up in rows, preferably arranged so as to alternate with each other or to cross each other netwise so as to form chequerwork of superimposed rows of contact pieces, without any supports being necessary and without any possibility of the gases or liquids flowing directly and unimpeded through the chamber or tower. The liquid running down from any of the rows or layers of packing material is sure to be converted into spray or into a stream or film in the next succeeding lower layer.

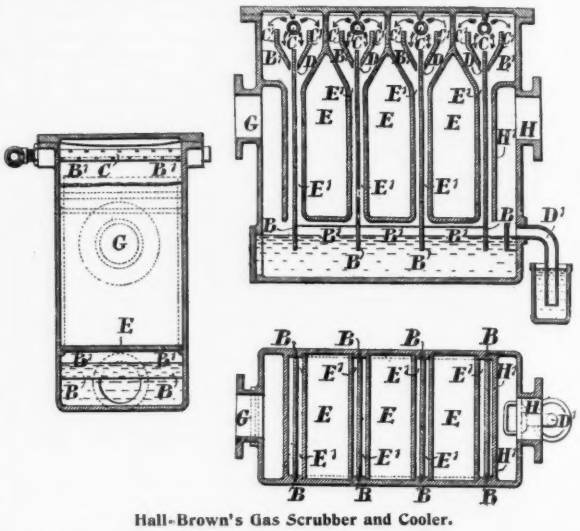
As compared with the usual plates, the packing material shown presents the further advantage "of a frequent change of direction of movement of the reagents; of a uniform wetting of both surfaces of the plates; and of an increased duration of contact of the various reagents." The plates are preferably given such an inclination that the liquid will trickle down in a uniform stream outside as well as inside the plates.

Combined Gas Scrubber and Cooler.

HALL-BROWN, E., of Kelvinside, Glasgow.

No. 23,078; Oct. 17, 1907.

In this combined scrubber and cooler, water is used for the treatment of gas (producer or other) to remove impurities therefrom, and, at the same time, to assist in cooling the gas before it is allowed to pass into coke-scrubbers or like purifying plant of known construction.



Hall-Brown's Gas Scrubber and Cooler.

In the arrangement shown, plates B extend across the box, carried in grooves so as to be readily removable. The height of the plates is less than that of the box; and they are so positioned that they do not reach either the top or the bottom. The box is thus divided into a number of compartments B^1 opening into each other top and bottom. Above the upper edge of the plates, perforated pipes C also extend across the box. They are each closed at one end and connected at the other end to some source of water supply. Beneath the pipes and on either side of the upper part of each division-plate, a baffle-plate C^1 is so carried that its lower edge is in proximity to the surface of the division-plate; the two baffle-plates thus forming a channel-shaped receptacle through a slit D in the bottom of which the division-plate B projects, so that the water coming from the perforations in the underside of the pipe C is distributed in a thin film to, and runs down over, the surface of the division-plate on both sides. To assist in uniform distribution of the water over the division-plates, rolls of fibrous material (not shown) may, if desired, be placed so that they lie against the surface of the plates.

In each compartment B^1 there extends across the box a hollow metal shell E (preferably also carried in a groove in the sides of the box) of such dimensions that only a narrow channel E^1 is left between the division-plates and the sides of the shell. The upper side of the shell is made with an upstanding rib extending up to the under side of the cover of the box. Perforations are also formed in the upper side of the pipes C; and the baffle-plates C^1 are so shaped that the water is directed not only over the surface of the division-plates B, but also over the surface of the hollow shells E, thereby increasing the wetted surface. The water outlet D^1 is higher than the lower edges of the division-plates, so that a water-lute is formed, sealing the bottom of the compartments B^1.

The entrance G for the hot and impure gas is at the middle of one end of the box, where the baffle-plate directs it in contact with the water trickling down the surface of one side of the first division-plate. The gas ascends this side of the plate and passes through the water spray, over the upper edge of the plate, down the channel E^1 in contact with the wetted surfaces on that side of the plate, across beneath the first shell E, up the channel E^1 on the other side, and so on through each compartment B^1 in succession until it leaves by an outlet H and passes underneath a baffle-plate H^1 at this end of the box—its contact with the water flowing down the various channels E^1 "effectually removing impurities and abstracting a large proportion of its heat."

Inverted Incandescent Burners.

SUNLIGHT AND SAFETY LAMP COMPANY, LIMITED, and SMITH, T. B., of Birmingham.

No. 25,240; Nov. 14, 1907.

This invention relates to those inverted gas-burners arranged with a closed external glass globe and an internal cylindrical glass surrounding a mantle supported from a central porcelain supply tube. The invention consists of the combination therewith of improved means for supplying and directing air for combustion around the whole of the exterior of the mantle within the cylindrical glass, and for allowing the combusted gases to readily pass away. This is effected by two annular flues arranged concentrically to the central supply tube in such a manner that the inner annular flue is continued down to a point at or near the bottom of the mantle by the cylindrical glass. The fresh air

which passes down this flue is thus distributed over the whole of the exterior of the mantle, after which it passes away in an upward direction through the inner annular flue surrounding the central supply tube.

Rotary Engines, Pumps, or Meters.

KENNEDY, D., of Higher Tranmere, Cheshire.

No. 26,529; Nov. 30, 1907.

This invention relates to improvements in rotary engines, pumps, or meters of the kind in which pistons or vanes are adapted to slide radially in and out in the rotary drum, so as to either fill the space between the outside of the drum and the inside of the cylinder or be withdrawn inwards to pass a partition or bulkhead. The specific improvements introduced are as follows.

1.—The pistons that slide in and out of the drum are forked at their inner ends; and the slots or depressions in the drum to receive them are made of a shape to correspond with the forked shape of the pistons—thus leaving a good body of metal at the middle of the drum, so as to maintain its strength. The arms of the fork can thus extend to near the centre of the drum without weakening it. The cross-heads or gudgeons which engage, and travel in, the cam-races are mounted on the arms of this fork—the object being to obtain a small diameter of cam-race, as the smaller the race the less travel there is for the gudgeons, and therefore less friction, while at the same time the strength of the drum is maintained.

2.—The cam grooves or races are formed in adjustable side-plates at each end of the cylinder.

3.—At each end of the cylinder is a rib concentric with the cam-race, which forms a circular abutment against which the ends of the pistons rest, so that in case a gudgeon should break the abutment ensures the pistons being forced into the drum and prevents them striking against the bulkhead.

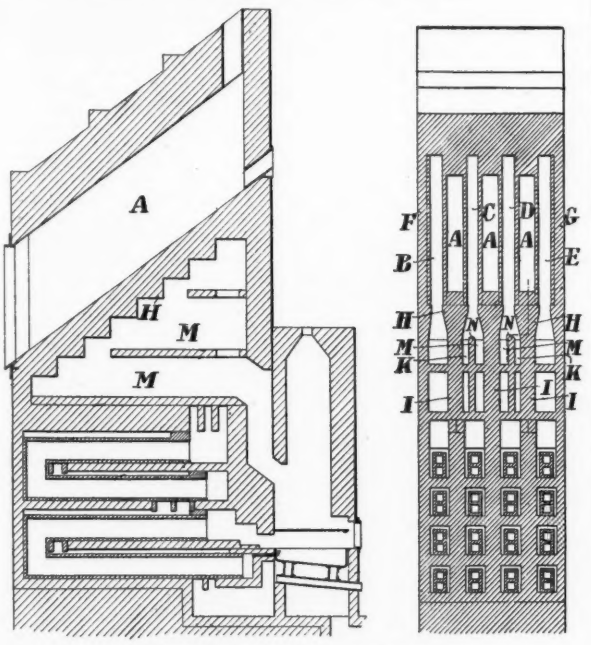
4.—At each side of the pressure bulkhead is a main port and an auxiliary port, with a valve for admitting steam. The drum, by close contact with the bulkhead and the packings therein, prevents the passage of steam past the bulkhead, and, furthermore, the drum normally closes the auxiliary ports.

Retort and Chamber Furnaces.

RIES, HANS, of Munich, Germany.

No. 1673; Jan. 24, 1908. Date claimed under International Convention, Jan. 26, 1907.

According to this invention, the retorts or chambers (arranged side by side) are each supported throughout the entire length on pillars of masonry or the like which extend to the foundations of the furnace, and have no conduits of any kind formed in them. The bases of the retorts, as has already been proposed, overhang their supporting pillars; and, according to the present invention, immediately below such overhanging portions are formed openings in conduits for gas and air, disposed and separated as hereafter described. "Combustion thus takes place immediately below the overhanging base or that part of each chamber best able to withstand great heat without any conduits or channels being formed in any of the supporting pillars or bases of the retort chambers; the lateral walls of the retort chambers being at the same time protected from direct contact with the hottest gases, thus increasing the durability of the whole furnace.



Ries's Retort and Chamber Furnaces.

In the construction shown, three inclined retorts A are arranged side by side—all separated from each other and from the side walls F G of the furnace by passages B, C, D, E, which serve to conduct the heating gases. The lateral walls of each retort-chamber rest on bases or sill-stones H, "of substantial construction," overhanging on either side the pillars I, of masonry or the like, by which they are supported. These vertical pillars have no conduits or channels formed in them; and transmit the weight of the retorts and their contents direct to the foundations of the furnace—thus "obviating to a large extent any chance of the inner structure of the furnace, retorts, or regenerator channels altering in shape."

Below the overhanging portions of the sill-stones are arranged conduits K M (for air to support combustion and gas whereby the retorts are heated) separated by a partition N. The partition terminates immediately below the projecting portions of the sill-stones; and since the channels have openings on either side of the partition, combustion takes place in the space limited laterally by the overhanging walls of the sill-stone—immediately below the base of each retort.

The bases of the retorts are thus heated to a sufficient extent, the patentee claims, without it being necessary to provide heating conduits in them or in their supporting pillars. Moreover, since the combustion of heating gases takes place in the space beneath the bottom walls of each retort, the lateral walls of the chambers are less damaged, as they are outside the hottest combustion zone.

Gas-Fired Kilns for Bricks, Pottery, &c.

BÜHRER, J., of Konstanz, Grand Duchy of Baden.

No. 4722; March 2, 1908.

In continuous gas-fired kilns used for firing bricks, pottery, and the like, it has already been proposed to effect the introduction of the gas directly from the conduits through the side walls of the furnace and vertical conduits arranged therein—each set of vertical conduits being led off from an independently controlled branch conduit for the supply of gas. But the vertical conduits in these systems are led off in series from the branch supply conduit, and thus such as are far away from the source of supply obtain less gas than those near it. According to the present invention, the conduits are placed in communication with distribution boxes to which controllable gas supply pipes lead, and which "enable the control of the firing to be more efficiently carried out than was possible when these vertical tubes or passages were fed from a common transversely arranged branch conduit." The distribution boxes are arranged underneath the furnace and feed the vertical tubes or channels from below.

Utilizing Naphthalene for Internal-Combustion Engines.

RUTGERSWERKE-AKTIENGESELLSCHAFT, of Berlin.

No. 7594; April 6, 1908. Date claimed under International Convention, May 15, 1907.

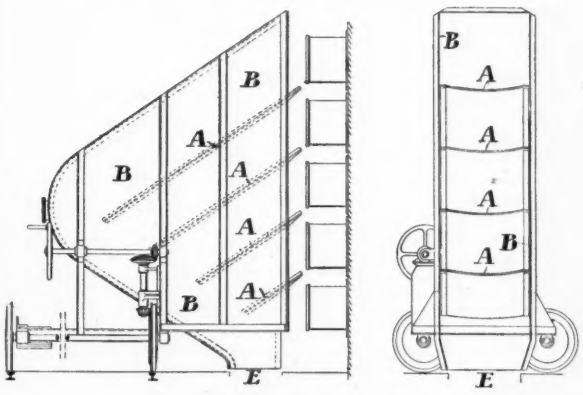
The patentees propose a method of using naphthalene and similar solid substances for driving internal-combustion engines, characterized by the fact that these substances are dissolved in the liquid fuels hitherto usually employed—the exhaust gases or the circulation water of the motor being utilized as the source of heat. The place in which the solution is prepared is located in such close proximity to the explosion chamber that separation of solid matter cannot take place in the supply conduit as a result of cooling during transmission from the solution chamber to the engine cylinder; the proportion of naphthalene being increased, decreased, or entirely eliminated at will.

Discharging Coke from Gas-Retorts.

CHANDLER, D., of Old Kent Road, S.E.

No. 8000; April 10, 1908.

This apparatus is intended to be used in connection with horizontal through gas-retorts, from which the coke is discharged at one end by means of pushers (hydraulic or otherwise) introduced at the other. The patentee's object is to avoid breaking-up the coke in its fall by providing an arrangement comprising a combination of inclined trays in different positions to suit the various heights of the retorts being discharged, so as to receive the coke and transfer it to a guide leading to the coke hole or other receptacle.



Chandler's Coke-Discharging Shoot.

In the illustration—a side elevation and a front view—A are inclined trays placed one over another in a metal body or case B. The higher ends of the trays are nearly on a level with the bottom of the retort mouthpieces when the apparatus is in position. The coke pushed out of the retorts falls on to the trays and slides down the latter on to the back of the case, which is also inclined (but in a forward direction), and forms a shoot common to all the trays, delivering the coke out of the bottom of the case into the hole E, beneath which receptacles may be placed if desired. The apparatus is preferably carried on wheels running on rails in front of the retort-bench; and hand

gearing may be arranged for traversing the apparatus up and down its track.

Instead of several trays arranged one above the other, one tray capable of being shifted into the different positions to suit the position of the retort might be employed; but in every instance the bottom of the casing remains fixed, and constitutes a shoot.

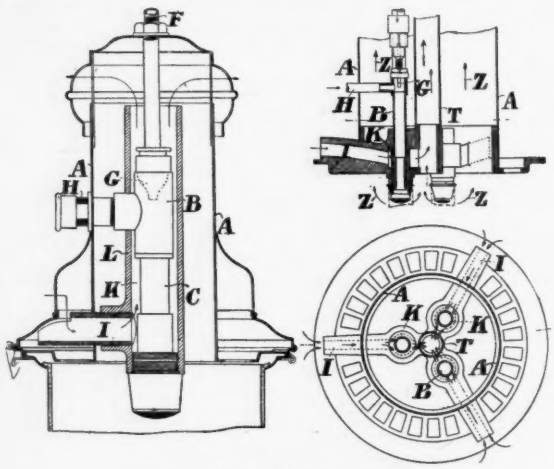
Inverted Incandescent Gas-Lamps.

GRAETZ, M., of Berlin.

No. 9276; April 29, 1908.

This invention relates especially to such inverted incandescent gas-lamps as work with pressure gas and the burners and burner-tubes of which are arranged within the chimney, with the result that they "become excessively hot, so that back-firing of the flame is frequently caused."

The burner-tube it is proposed to provide with a chamber or jacket for part of its length within the chimney, through which atmospheric air can pass upwards, so as to effect the necessary degree of cooling. By passing the air upwards (as opposed to prior air-circulating devices), a much better effect is said to be secured. In the case of multiple burner lamps, the space between the burners form a kind of *cul-de sac*, in which there is little or no circulation. The hot gases settling here rapidly cause the excessive heating of the metal frame employed for carrying the burner-tubes; and this heat is, of course, carried by conduction to the burner-tubes. In multiple-burner lamps the invention avoids this danger by providing an outlet leading directly from the space between the burners, and into which the air-cooling chambers for the various burner-tubes open. In this way a double purpose is served—the accumulation of heat in the burner-tube carrying frame is prevented, and the air current through the several air-cooling tubes is stimulated.



Graetz's Inverted Burner Lamps.

In the single-burner lamp shown, the chimney or upper lamp casing A surrounds and encloses the burner-tube B, in which the air from an air inlet tube H and the gas from the pipe F are mixed. From this chamber the mixture passes downwards through a tube C to the burner-head. Around the burner-tube there is arranged a tube L, to which air passes from the atmosphere through openings in the lamp casing, and a connecting pipe I at its lower end to the annular space K formed between the burner-tube and the air-jacket tube. The upper end of the air-jacket tube is open; and the air which has circulated through the annular space K passes, together with the exhaust gases from the lamp, through openings formed in the hood. The air-inlet pipe H passes through the wall of the casing, and is provided at its exterior end with a regulating cap. In this way the air passing through the air-tube H and the gas at high pressure passing from the nozzle G are efficiently mixed and the proportions of the mixture easily controlled.

The passage of the exhaust gases from the lamp causes a suction through the pipe I and the cooling space K; and this air sucked from the atmosphere carries away the heat conducted by the metal of the burner-tube from the burner-head, and thereby prevents them "reaching an abnormal temperature such as would cause firing-back of the air and gas passing from the mixing-chamber to the burner-head."

In the form shown with three burners and burner-tubes, the tubes B pass through, and are supported in, a casing or frame provided with air inlet tubes or passages I leading to an annular cooling chamber K, arranged at the lower end of the burner-tube B and adapted to prevent the transmission of an excessive amount of heat from the burner-pipe to the mixing-chamber part. The air-tubes all communicate with a central tube T, which opens into the space between the burners. In this way exhaust gases from the burners are prevented from settling in the space between the burners, and pass upwards, as shown by the arrows. The remainder of the exhaust gases pass, as indicated by the arrows Z, upwards outside the pipe T. The effect of this is to improve the suction action through the pipes I and annular spaces K, as all the spaces are connected by passages with the central tube T.

Disc Water-Meters.

SIEMENS BROTHERS AND CO., LIMITED; a communication from SIEMENS AND HALSKE ACTIENGESELLSCHAFT, of Berlin.

No. 13,088; June 19, 1908.

This invention refers to the lubricating of the moving parts of a water-meter—such as the disc, the bearing balls, and the like. There are obvious objections to the use of oil for this purpose, as, on the one hand, it mixes with the water, and, on the other hand, it would be ineffective in the case of hot-water meters. In the latter case, also, vulcanized india-rubber, celluloid, and the like are excluded from use. It has been suggested to enclose the disc-balls in a bearing of self-lubricating material by forming the bearing of concentric rings of graphite between metal ribs; but this method does not long remain effective, as the disc and the metal ball still come into rubbing contact with the metal parts of the casing, and after the graphite has been partly worn away, the disc ball again rubs against the metal ribs. The present invention suggests that the movable parts of the meter—such as the disc, disc ball, guide, and roller—should be partly or entirely made of adense or compressed carbon or graphite or a self-lubricating material containing graphite, possibly made in several segments held between metal discs which are rigidly fixed together by screws, and pressed by springs against the wall of the casing.

LEGAL INTELLIGENCE.

CURIOUS COMPENSATION CASE AT SWANSEA.

A Successful Defence.

At the Swansea County Court, last Tuesday, Thomas Elson, a yard labourer, claimed compensation from the Swansea Gas Company for an accident; his allegation being that a large piece of gas coke had fallen on his foot and injured it, so that he had been out of work since April 17, and was permanently disabled. The Company granted him gratuities for three weeks; but he still absented himself from work, and finally applied to the Court. The Company's contention was that the man was malingering, as no sign of injury or misplacement of bones was observed in the early part of his absence from the works.

It was explained by Mr. L. Williams, who appeared for the applicant, that Mr. George T. Andrews, the Manager, was the only eye-witness; but neither he nor applicant thought much of the accident at the time. Subsequently the foot became painful, and applicant was eleven weeks in the hospital. A sum of 15s. was paid him; but Mr. Andrews said it must be understood that it was a gratuity. A similar sum was afterwards paid without comment, which Counsel contended was an admission of liability; and then 10s. was offered and declined. Applicant said he had been in the Army, but was bought out by his mother. He denied that his discharge was marked "Bad."

For the Company, Mr. L. M. Richards produced a piece of coke about the size of an egg, suggesting that this was what had struck the applicant's foot, and that it was dropped by Mr. Andrews from above in order to attract his attention. Applicant, however, pooh-poohed the suggestion, on which Counsel added that Mr. Andrews did it so that he might tell him not to go on idling away his time.

Mr. J. L. Edwards, the parish doctor, said that he examined applicant's foot six weeks after the accident, and found the bones had been displaced and applicant permanently disabled. Mr. Richards, in cross-examination, put it that there was nothing inconsistent about the injury with the man having wilfully wrenched his foot. Witness said the injury might have been produced by a wrench; but it was absurd to say it was wilfully done. The coke must have struck applicant on the instep; and such a blow would cause the displacement of the bones. Dr. Evans said a radiogram of the injury showed the displacement was outward. The accident was the initial cause; but subsequent inflammation might have contracted the tendons. Unless there was congenital deformity, he did not think that in such a short time applicant, by wilfully walking on the outside of the foot, could have produced the present condition. Dr. Robert Edwards gave similar evidence.

Mr. George Andrews, for the defence, stated that a bucket was covering applicant, so that it was impossible for a piece of coal or coke of the weight of 9 or 10 lbs. to have hit him. As a matter of fact, witness, from a height of about 7 feet, dropped a small piece of coke on him to attract his attention, as the man was idling his time. Elson came up to him and said that someone had just hit him on the foot. Witness said: "I threw the coke. Is your foot hurt?" Applicant was also asked to take his boot off, but he walked off, and not only continued to work, but went to dinner as usual, and returned to work afterwards. A fellow workman gave evidence to the effect that he never saw Elson walk lame until a week after the alleged accident.

Dr. Elsworth said the condition of Elson's foot, when he saw it in July, was quite consistent with Elson having exerted pressure on the outside of it. Dr. W. F. Brook unhesitatingly declared that applicant was malingering; and Dr. Berry, of the Swansea Hospital, also gave evidence for the defence.

Dr. Marshal Jones was the Medical Referee, and sat with the Judge; and at the close of the case he had applicant before him in the private room. After consideration, the decision of the Court was against the applicant, Judge Bryn Roberts saying he had come to the conclusion that the present condition of the foot was not caused by the accident. He also very much doubted whether any accident occurred, other than that stated by the Manager. He was not satisfied that this accident was responsible for the present state of affairs, and he therefore found for the Company, with costs.

Lewes Gas Company.—The revenue account of the Lewes Gas Company for the six months to June, the Directors stated in their report, showed a profit of £1390. After providing for interest on mortgages, &c., the balance of net revenue was £2651. The Directors recommended dividends for the half year at the rate of 5 per cent. on the original capital stock and at the rate of 3½ per cent. upon the additional capital stock. These dividends would amount to £1409. Appreciative reference was made to the services of Mr. Levi Monk, who retired in June, after fourteen years' service with the Company. The report was adopted at the meeting of shareholders. The belief was expressed by the Chairman (Mr. C. R. Kemp) that Mr. Monk's successor, Mr. Edward Jones, would prove an excellent Manager.

MISCELLANEOUS NEWS.

SULPHATE OF AMMONIA COMMITTEE.

Report for the Year Ending June 30.

The report of the Executive Committee of the Sulphate of Ammonia Committee for the financial year ending June last, which was submitted at the recent meeting of the contributors, contained the following paragraphs.

The Committee have continued their practice of offering prizes, through the medium of Agricultural Societies and Farmers' Clubs, for the best crops of roots and potatoes grown with the aid of sulphate of ammonia; and during the period under notice the following competitions were carried out in the classes named :—

Yellow turnips	11 competitions.
Swedes	29 ,,
Mangels	35 ,,
Late potatoes	3 ,,
	78

Prizes were also offered for early potatoes and field cabbage; but no competitions were organized in either of these classes—preference being given to those previously mentioned. As in previous years, several competitions were abandoned owing to insufficient entries, and to adverse climatic conditions. However, although the year 1907 was, generally speaking, a bad one for roots and potatoes, some excellent crops are reported.

The Committee's experimental plots at the Irish International Exhibition, Dublin, were an unqualified success, and demonstrated the value of sulphate of ammonia so conclusively that they must undoubtedly prove a valuable advertisement for the product. A report on these experiments was circulated among subscribers in January last, and was reproduced *in extenso*, with editorial notices, in the "JOURNAL OF GAS LIGHTING" and other papers, and was also included in the annual report on agricultural competitions, of which 20,000 copies were printed and circulated.

The Executive Committee have acquired plots of land in the grounds of the Scottish National Exhibition, Edinburgh, where experiments similar to those made in Dublin are being carried out with every prospect of good results.

The Committee continued their usual practice of advertising in the chief agricultural papers during the past manurial season, and have had in addition some 200,000 copies of a coloured inset advertisement bound up in the schedules and show catalogues of some 75 leading agricultural societies. The Committee have had prepared some large show-cards and some of a special finish which they will be pleased to distribute to subscribers on application. These are suitable for exhibition in show-rooms, in dealers' warehouses, &c. The Committee's enamelled window lettering, "Sulphate of Ammonia and Other Fertilizers," has during the year been placed on the business premises of about 200 agricultural dealers, seedsmen, &c. These permanent advertisements have now been fixed on the windows of about 450 dealers in different parts of the kingdom. About 175,000 copies of the pamphlet, "Sulphate of Ammonia, the Best and Cheapest Form of Nitrogen," and upwards of 100,000 copies of "Some Hints on the Successful Use of Artificial Manures in the Garden, &c.," have been circulated during the year, chiefly through the medium of agricultural dealers, seedsmen, florists, &c., whose names and addresses were printed on the covers of the pamplets.

The Committee's representative, besides attending the various Agricultural Shows mentioned below, has spent a good deal of time in visiting new centres in England and Wales, and in getting in communication there with all who would be likely to be interested in sulphate of ammonia. During the year under notice, the Committee have exhibited at the following Agricultural Shows: The Highland Agricultural Society's Show at Edinburgh, July 9 to 12, 1907; Yorkshire Agricultural Society's Show at Barnsley, Aug. 8 to 10; Somerset Agricultural Society's Show at Wellington, May 13 and 14, 1908; Oxfordshire Agricultural Society's Show at Abingdon, May 20 and 21; Bath and West and Southern Counties Agricultural Society's Show at Dorchester, May 27 to June 1; Essex Agricultural Society's Show at Colchester, June 10 and 11; Herefordshire and Worcestershire Agricultural Society's Show at Kidderminster, June 16 to 18; and the Royal Agricultural Society's Show at Newcastle-on-Tyne, June 30 to July 4. Since the close of the financial year, the Committee also exhibited at the following shows: The Lincolnshire Agricultural Society's Show at Sleaford, July 15 to 17, 1908; Tunbridge Wells and South Eastern Counties Agricultural Society's Show at Tunbridge Wells, July 23 and 24; Leicestershire Agricultural Society's Show at Leicester, July 29 and 30; and the Yorkshire Agricultural Society's Show at Halifax, Aug. 5 to 7, 1908.

The Committee have pleasure in reporting that 34 new subscribers, with an estimated annual production of about 7500 tons of sulphate of ammonia, have joined since July of last year; but as the membership of some of the most important of these who have quite recently joined only commences as from July 1, 1908, the benefit from this addition to our tonnage has not yet been fully felt. The subscriptions for the year under notice represent a further substantial increase in the gross tonnage of contributing manufacturers, compared with the preceding year, equal to about 12,800.

During the manurial season just ended, the home demand for sulphate of ammonia has been unprecedented; and it is with some regret that we have to record the fact that many instances have come under notice where makers have been quite unable to supply local requirements.

We would here urge on subscribers the desirability of making more ample provision for future local needs than many have apparently done in the past.

SHEFFIELD UNITED GASLIGHT COMPANY.

Resignation of Sir Frederick Mappin.

The Half-Yearly Meeting of the Sheffield United Gaslight Company was held on Monday of last week in the Cutlers' Hall, Sheffield, under the presidency of Mr. WILSON MAPPIN.

The CHAIRMAN said he was sure all would regret to hear that Sir Frederick Mappin, on account of advancing years, had felt himself obliged to relinquish the post of Chairman of the Company which he had held for so many years past. His resignation had been considered by the Directors at the Board meeting that day; and they had passed a resolution which he proposed to have read later on, as he felt sure the shareholders would wish to associate themselves with it. The first matter referred to in the report was the satisfactory increase in the quantity of gas sold during the half year, which amounted to 6·59 per cent. more than in the corresponding period of 1907. This extra consumption was the more pleasing, as it followed considerable increases in previous years. He found, on looking back, that the quantity of gas sold during the twelve months ended June 30, 1905, was 2746 million cubic feet, and that during the past twelve months 3379 millions were sold—an increase of no less than 633 million feet, or 23·05 per cent., in three years. He thought the shareholders would regard this as an indication of the continued popularity of gas, and of the stability of their business. The increase was all the more remarkable when the large saving in consumption effected by the use of incandescent burners over the old flat-flame burners was borne in mind. He did not think they could reasonably expect that the next twelve months would show any advance in consumption, as the present outlook for trade in the city was, he regretted to say, the reverse of encouraging. However, consumers would enjoy the advantage of a very cheap supply of gas; the average price during the past half year having been slightly under 1s. 3d. per 1000 cubic feet. The accounts would have shown that, notwithstanding the large increase in business done by the Company, the dividend had not been fully earned, but that some £8750 would have to be taken from the balance brought forward. The Directors were quite prepared for a deficiency on this occasion, which was more than accounted for by the high price of coal; the extra cost during the past half year over the corresponding six months having been £22,137. In addition to coal, the following increases in their expenditure had been incurred: Stokers' wages, £1181 more; repairs of works, £357 more; repairs of mains and services, £1446 more; while repairing meters and stoves cost £971 less. On the other side, they had received £2570 more for gas, £381 more for meter-rents, £3727 more for coke, £1191 more for sulphate of ammonia, and £304 more profit on the fittings department. The decreased receipts had been: Tar £398, and the Company's railway waggons £268. The net result was that the profit on the half-year's working was insufficient to pay the dividend by £8755. After deducting this sum, the balance left to be carried forward would be £86,795. There had been 35 additional gas-engines fixed during the half year, varying in size from ½ to 150 H.P.; the total horse-power being rated at 1028. During the twelve months, 331,623,000 cubic feet of gas had been supplied to engines. This was an increase of 37,848,000 cubic feet over the corresponding period. There had been sold 607 gas-fires, 967 boiling, grilling, and other stoves, and 8549 incandescent burners, and 151 additional cookers let on hire during the six months. The City Council, at their meeting in May last, decided to substitute electricity for gas in certain streets in the centre of the town, regardless of the fact that the cost of lighting them would thereby be considerably increased. These thoroughfares were already sufficiently lit, and the only reason for the change that occurred to him was the desire to assist the Electric Light Department at the cost of the city rates; and, being very large ratepayers, he thought that the Gas Company had every right to complain, more especially as the Electric Lighting Department was already highly favoured at the expense of the ratepayers, as they would see when he told them that the department only paid in rates for the year ended March 31, 1907, £1613, although their profit was £49,883; while the Gas Company, whose profit was £89,768, paid £18,251 in rates. Of course, the profits of the Electric Light Department were subject to payment of interest and sinking fund, and in like manner the Gas Company's profit was subject to the payment of the dividend. The Gas Company thus paid, with a profit of less than double the amount of the Electric Light Department, more than eleven times as much in rates. The Electric Light Department were therefore either paying far less than they ought to do, or the Gas Company paid a great deal too much. (Hear, hear.) Electricity was not the only department favoured, as he found that all the Corporation trading departments were treated very leniently as regards the rates paid. They would be astonished to hear, and the citizens generally would, he thought, be surprised to learn, that the Water, the Tramways, and the Electric Light Departments, with a combined total capital of over £4,000,000, and a profit in 1907 amounting to £286,769, paid only £21,658 in rates, against £18,251 paid by the Gas Company, with a capital of only £970,355 and a profit of £89,768. One thing they might be certain of, that if the undertakings belonged to private companies they would contribute far more largely to the rates than they were doing under present conditions. The consumers were probably not aware that for every shilling they paid for gas, 1·06d. of it went for rates; but such was the fact—a pretty considerable tax for a Free Trade country. He moved the adoption of the report and balance-sheet.

The SECRETARY (Mr. William Hamby), at the request of the Chairman, read the resolution passed by the Board of Directors: "Resolved, that this Board has received with much regret the communication from Sir Frederick Mappin of his decision to resign the chairmanship of the Company, a position which he has occupied for the long period of 35½ years; and feeling that in his present state of health it would be unkind to ask him to reconsider his determination, the Directors desire to place on record their opinion that it is hardly possible to estimate the value of the services Sir Frederick has, by the exercise of his exceptional business abilities, rendered both to the Company and also to the consumers of gas in Sheffield, and they consider that the sound position in which the Company now stands is largely due to his splendid judgment, and to the devotion of time and energy which he

has so ungrudgingly given to its affairs, and they trust that, freed from the anxieties of business, he may now enjoy a season of repose, during which they feel sure that he will look back with considerable satisfaction to his long connection with the Sheffield Gas Company."

Mr. H. K. STEPHENSON seconded the adoption of the report and balance-sheet. It was, he said, perhaps very difficult for those who had not been in such close touch with the Company to realize the unremitting attention which Sir Frederick Mappin gave to the work. He treated it entirely as though it was a business of his own—and in a sense it largely was so. He gave quite as much attention to it as many a man did to the business which was his sole concern; and he did this in spite of the fact that he had so many other interests—one of them no less than the representation of an important parliamentary constituency during a long proportion of the time. It was a matter of some pleasure that they would still have him with them as a Director, and that his health was now very considerably better than it was some time ago. The Board had that morning elected Mr. Wilson Mappin as their Chairman in place of Sir Frederick; and it was well known that Mr. Wilson Mappin had acted in Sir Frederick's place recently, and given an attention to the work no less unremitting.

The resolution was carried.

A dividend was declared of 5 per cent. on the "A," "B," and "C" stocks.

Mr. Ebenezer Hall, Mr. Wilson Mappin, and Mr. Robert Leader, who retired by rotation, were re-elected Directors.

A hearty vote of thanks was passed to Mr. Wilson Mappin and his colleagues on the Board and the officers of the Company for their services during the year.

HARROW AND STANMORE GAS COMPANY.

Notable Business Progress—Decreased Cost into the Holder and Low Fuel Account.

The Half-Yearly Meeting of the Company was held yesterday week, at the Holborn Restaurant—Mr. ALFRED H. BAYNES in the chair.

The ENGINEER and SECRETARY (Mr. J. L. Chapman) read the notice of meeting; and the report and accounts were taken as read.

The CHAIRMAN, in moving the adoption of the report and accounts, said that, at the last half-yearly meeting, he had the pleasure of congratulating the shareholders upon the marked progress and prosperity of the Company; and that day he was glad to be able to state that the results of the business for the past half year indicated a still further advance. He thought this would be abundantly clear by a brief comparison of the figures for the past six months with those for the corresponding term of 1907. In making the comparison, it should be remembered that the price charged for gas during the whole of the past half year was 2d. per 1000 cubic feet less than in the corresponding period of 1907. The gas-rental for the half year was £14,179—an increase of £1207. Coke and the other residuals exhibited an increase of £629. The total receipts were £18,878—an increase of £2068. The total expenditure was £13,012—an increase of £1619. This increase was largely accounted for by an additional 654 tons of coal having been carbonized, at an extra cost of £1185; this sum including the enhanced price on the total quantity of coal carbonized. A smaller amount of oil was used by 2948 gallons. The inspection and repairing of mains, meters, and stoves together had cost £333 more. Among other items mentioned was the increase of the workmen's insurance fund to £275. Regarding depreciation, £203 had been written off the value of cooking-stoves, £436 off meters, and £100 off house services. The quantity of gas made during the half year was 83,734,000 cubic feet. Of this, 59 581,000 cubic feet was coal gas; the amount of coal used being 5310 tons, yielding 11,220 cubic feet of gas per ton. The quantity of carburetted water gas made was 24,153,000 cubic feet, in the manufacture of which 54,207 gallons of oil were used, producing 1000 cubic feet of gas for 2·24 gallons of oil. The quantity of gas sold was 80,299,000 cubic feet, which was equal to 95·89 per cent. of the make. The amount of gas used on the works was 1,087,000 cubic feet, which was equal to 1·29 per cent. of the make. The quantity of gas unaccounted for was 2,348,000 cubic feet, or 2·82 per cent. of the make. During the half year, the sales of gas had increased by the following amounts and percentages: The increase in the Harrow district was 4,933,000 cubic feet, or 12·50 per cent.; in Sudbury and Harrow Weald, 3,228,000 cubic feet, or 28·91 per cent.; in the Stanmore district, 1,014,000 cubic feet, or 7·03 per cent.; and for public lighting, 956,000 cubic feet, or 18 53 per cent. The total increase in the amount of gas sold during the half year, compared with the corresponding period of 1907, was 14·43 per cent. The increase in the gas sold during the past six years had amounted to 66·27 per cent. The total profit for the half year was £5856; being an increase of £449 on the first half of last year. The dividends recommended in the report would require £4477; and interest on loans and debentures, £739—together £5216, and leaving a balance of £650. Deducting £296 to be transferred to the reserve fund, there was a balance of £353 to be carried to the sum of £3639 brought forward from the previous half year; making the balance in hand £3993. He ventured to think they might regard the results of the half-year's working as most satisfactory; inasmuch as, notwithstanding a reduction in the price of gas for the whole of the past six months, and an increase in the cost of coal, the receipts and profits were larger than in any previous half year of the Company's history. They were paying the statutory dividends, and increasing the reserve fund and the balance to be carried forward to the next account. These results, the Directors felt, were very largely due to the excellent management of the Engineer, Mr. Chapman, who devoted himself with such ability and energy to increasing the prosperity and progress of the Company.

Mr. HORACE RYDON seconded the motion.

Mr. LOUIS PENNY said he saw that the balance overdrawn on capital account was £7682, that there was a balance due to the bankers of £1814, and that there was a temporary loan of £500. There was an uncalled capital of over £56,000. Why was not some of this capital issued to the shareholders, so that they might get the benefit of it?

The CHAIRMAN replied that the Directors would have to sell the additional capital by auction, so that there would be no special advantage to the shareholders. Just at present, they could work to the better advantage of the Company by borrowing from their bankers; but undoubtedly before long some of the additional capital would have to be issued.

Mr. JOSEPH CASH said he must congratulate the Board upon their record account for the past half year. Notwithstanding the increase in the cost of coal, and a decrease in the price of gas, the Company had earned the full dividends, and were carrying something to the reserve fund. Another record that he saw had been made was that the cost price of gas into the holders was less than it was in the corresponding period by ½d. per 1000 cubic feet. He (Mr. Cash) had taken out the statistics of a great number of companies; and he had found that, owing to the increase in the cost of coal and other material, their costs into the holder had been increased. In this case, however, it had been decreased; and he congratulated the Board and the Company's Engineer upon it. There was another thing that stood to Mr. Chapman's credit, and that was the extraordinarily low fuel account that he had reached. How he got it, he (Mr. Cash) did not know. It worked out, so far as he could see, to something just under 13 per cent. This was remarkably low; and he did not know of any other company doing it at the same figure. The unaccounted-for gas was also notably low; and altogether the account was one of which the Board and the Engineer might be very proud.

Mr. F. LENNARD supported these remarks, and added that he thought it should be left entirely to the discretion of the Directors as to whether they borrowed money from their bankers or issued new capital. If they could effect a saving by going to the bankers, he should advise them to do so. If money could be borrowed cheaper than by raising fresh capital, it was a wise step to take.

The motion was unanimously carried.

The CHAIRMAN moved the declaration of dividends at the rate of 10 per cent. per annum on the original "A" capital, and of 7 per cent. on the additional "B" and "C" capital and the guaranteed shares, all less income-tax, and the transference of £296 8s. to the reserve fund.

Mr. RYDON seconded the proposition; and it was unanimously carried.

Moved by Mr. A. F. PHILLIPS and seconded by Mr. CASH, a hearty vote of thanks was passed to Mr. Chapman for his services.

Mr. CHAPMAN thanked the shareholders, and warmly eulogized the services of his assistants, staff, and the workmen generally. With regard to Mr. Cash's observations as to the fuel account, he (Mr. Chapman) had an excellent assistant who went very fully indeed into the question of carbonization; and he had a very clear knowledge of fuel gases. He went deeply into this subject, and that was one of the reasons for their particularly good balance-sheet. They really took a great deal of interest in the fuel account, and examined it from day to day.

Moved by Mr. F. R. SMITH, and seconded by Mr. LENNARD, the Chairman and Directors were also cordially thanked for their services; and the proceedings terminated.

DOVER GAS COMPANY.

The report submitted at the half-yearly meeting of the Company on Monday of last week stated that though, as foreshadowed in the last report, the profits of the six months to June 30 were insufficient to provide the full parliamentary dividend, it would only be necessary to take a sum of £488 from the surplus profits of past years to enable a dividend at the usual rate of 7½ per cent. per annum to be paid for the half year; and the Directors accordingly recommended the declaration of a dividend at this rate. The coal contracts had been renewed at a considerable reduction on the prices of the previous twelve months, thus justifying, the Board remarked, their policy in not raising the price of gas during last year to meet the increased cost of coal. They regretted to announce the death last March of Mr. T. N. Kirkham, who for forty years was connected with the Company as Consulting Engineer.

In moving the adoption of the report, the Chairman (Mr. Willsher Mannering) said the high price of coal had been felt to the full extent during the past half year; and there had also been a disappointing decrease of 3½ per cent. in the consumption of gas. He thought this might to a large extent be attributed to the increased use of the small, but effective, inverted incandescent burners, and to the very depressed state of trade and diminished prosperity. Nevertheless, it was pleasing to report that they would only have to take £488 from the surplus profit balance of former years to pay the full dividend. Under the circumstances, the financial result of the half-year's working might be regarded as highly satisfactory. As compared with the corresponding half of the previous year, the expenditure side of the revenue account showed in manufacturing an increase in the cost of coals of £1008. Though the quantity used was less, the cost was 3s. 4d. per ton more. Repairs and maintenance of works and plant cost £223 more. On the other hand, purification was £33 less, and salaries and wages also £95 less. In the distribution charges, repairs and renewals to mains were £244 less, and repairs and renewals to meters £812 less. The difference in this item was mainly due to the Directors having written off 2½ per cent. for depreciation on the slot-meter fittings, as against 7½ per cent. in the corresponding half-year. Rates and taxes were £67 more; and the total increased expenditure was £138. Turning to the revenue side, sales of gas had been £562 less, meter and stove rentals £3 less, and residuals (with a reduced make) £74 less—making a total decreased revenue of £639. The half-year's profits, including £125 received for interest, amounted to £3833, to which was added the sum of £4955 brought forward from the previous half year, making a total of £8788. After providing for interest on loans and placing £250 as usual for depreciation to the Trevanion Street holder suspense account, there was a sum of £8030 available for dividend. The dividend will take £3562; and there would remain a balance of £4467 to be carried forward. As regarded the future, the reduced price at which they had bought their coal for another year should effect a saving of upwards of £2000. This it was anticipated would enable the dividends to be earned,

and provide for a new roof to one of the coal-stores. It was with regret they had to record the death of Mr. T. N. Kirkham, who carried out important improvements, and in many ways rendered valuable services to the Company. He was in failing health for a long time, and passed away, he believed, on his 84th birthday. The Board continued to receive every assistance from the staff. The officers and men worked well together; and he felt sure they endeavoured to do their utmost for the prosperity of the Company.

The report was adopted, and the dividend recommended was declared; and votes of thanks were accorded to the Chairman and Directors, the Joint Secretaries (Messrs. George and E. C. Fielding), the Engineer (Mr. R. Herring), and the staff.

COLONIAL GAS UNDERTAKINGS.

Reports of the working of the following Colonial gas undertakings for the half year to June 30 have recently come to hand (in addition to those of the Australian Gaslight Company and the Melbourne Metropolitan Gas Company, already noticed in our pages).

The revenue of the Brisbane Gas Company from the sale of gas, &c., during the six months was £25,261; and there was a balance brought forward of £4492, making a total of £29,753. The expenditure on manufacture, &c., was £13,008; and £2676 was placed to the reserve funds. The net amount to the credit of the profit and loss account was thus £14,069, out of which the Directors recommended a dividend of 5½ per cent., which, with income-tax, would absorb £9240, and leave a sum of £4829 to be carried forward. The construction of a railway siding at the works is now in progress; while extensions of mains have lately been made in various localities. During the half year under review, contracts for street lighting were entered into with the town of Toowong and the shire of Toombul.

After allowing for reserve and depreciation, the North Shore (Sydney) Gas Company, Limited, realized a net profit on the sale of gas, &c., of £5937, which, added to a balance of £103 brought forward, left an amount of £6040 available. Out of this sum, the Directors recommended a dividend of 4 per cent. for the half year, free of income-tax. This would absorb £6000, and leave a balance of £40 to be carried forward.

The Maryborough (Queensland) Gas and Coke Company, Limited, brought into the accounts for the past six months a balance of £299. Sales of gas, fittings, &c., during the half year produced £3093, residual products £183, and interest £10. Thus there was a total of £3585, from which had to be deducted the expenditure of £2475, which left a disposable balance of £1110. After deducting from this £38 for income-tax, there was left a balance of £1072 at the credit of the profit and loss account. The Directors recommended the payment of a dividend for the half year at the rate of 6 per cent. per annum, tax free, which would absorb £774, and leave £298 to be carried forward.

BUDLEIGH SALTERTON GAS-WORKS.

In connection with the reconstructed gas-works at Budleigh Salterton, a formal opening took place last Wednesday of the retort-house, coal-store, and condensers. The new erections complete a scheme of reconstruction started about ten years ago, by which the original works have been entirely replaced by new and up-to-date appliances and machinery. The total outlay on the recent improvements has amounted to about £2500. Messrs. Willey and Co., Limited, of Exeter, were the Contractors. That the work was necessary is clearly demonstrated by the fact that in 1898 the Company carbonized 474 tons of coal, and made 3,839,580 cubic feet of gas; whereas in 1907 the figures were 785 tons of coal carbonized, and 7,777,850 cubic feet of gas made. The revenue from the sale of gas in 1898 was £702; and in 1907, £1627. The profits in 1898 were £184; and in 1907, £544. The old retort-house contained three settings, and was capable of turning out 35,000 cubic feet of gas per day; whereas in the new house the two settings will have a capacity for producing 80,000 cubic feet, and can, if necessary, be extended so as to produce 200,000 feet.

Mr. R. J. Rew, engineering representative of Messrs. Willey and Co., gave those present at the opening a lucid explanation of the works; and subsequently Mr. A. R. S. Perkins, the Chairman of the Gas Company, formally declared the additions to the works open. He said that, by the extension, they had already secured a very much larger yield of gas per ton of coal carbonized than with the old plant; and he had no doubt, with the excellent services of Mr. W. S. Walker, their Manager, they would very soon be able to recoup themselves for the outlay that had been incurred.

Luncheon was subsequently provided at the Rolle Hotel by the invitation of Messrs. Willey and Co., at which Mr. F. Templer Depree (Chairman of Messrs. Willey and Co.) presided. Mr. T. Glanfield, another Director, was in the vice-chair. The Chairman proposed "Success to the Budleigh Salterton Gas Company," and said that, considering the size of Salterton and the number of inhabitants, he should consider they had works as up-to-date as any in the West of England, and probably anywhere else. Their consumers, who numbered just over 10 per cent. of the population of 2000, were not quite up to the average in some other places around; but the more people came to appreciate the use of gas for lighting, as well as cooking, the sooner would an increase in the number of customers take place. The growth of make and consumption and the increase in the use of cooking-stoves and slot-meters were matters of very great gratification to the Board; and he wished the Company every possible success. Mr. Perkins, in reply, paid a tribute to the excellent manner in which Messrs. Willey and Co. had carried out the work. He spoke very highly of the Manager's services, and mentioned that when Mr. Walker started ten years ago the make of gas per ton was 8300 cubic feet, whereas it was now 10,400 feet. From 1898 to 1907 the revenue had shown a remarkable increase—from £702 to £1627.

LEEDS GAS-WORKS LOAN.

The Question of Bankers' Overdrafts.

A Local Government Board inquiry was held by Mr. M. K. North last Wednesday into an application by the Leeds City Council for sanction to borrow £65,000 for gas-works purposes.

The Deputy Town Clerk (Mr. T. Thornton) explained that the sum was made up as follows: £20,000 for expenditure in extending mains, £25,000 for new meters, and £20,000 for purchasing gas-stoves. It had been decided, however, that for the present only £10,000 should be spent under the last-mentioned head. In reply to questions by the Inspector, it was stated that the new mains and meters were intended to supply districts in various parts of the borough as the demand arose. With regard to the £10,000 for gas-stoves, it was quite a new idea to purchase these out of capital account. The Corporation were empowered to do so by the local Consolidated Act of 1905.

Opposition to the application was offered by Mr. Joseph Dransfield, who addressed the Inspector at some length. He said he had gone into the accounts for years; and he wished to refer to the question of overdrafts at the bank. Judgment had been delivered by one of the High Court Judges in reference to borrowing powers. All overdrafts at the bank, it had been held, were really borrowing powers; and the Leeds Corporation had no right to have an overdraft at the bank unless the Local Government Board were going to grant them powers to borrow the amount overdrawn. He had audited the gas account year after year, and it had always shown a very large overdraft at the bank. There was an overdraft now; and it was therefore illegal to borrow more money. He opposed the application, as he knew the financial condition of the city as well as any man in it. It was because of the serious state the city was in financially that the leaders of all parties in the Council said it was high time they stayed their hand in respect of capital expenditure. He therefore asked the Inspector to recommend the Local Government Board not to allow the Corporation to borrow any more money. He added that he had been told that day the rates of the city were about 8s. 6d. in the pound. He would like the Corporation officials to prove it now, because he could show they were nearer 9s. He prophesied that seven years hence the rates would be 11s. 6d. in the pound.

The Inspector: The remedy for this state of affairs seems to lie very much in your own hands. You are an elector, and therefore it seems to me that your remedy is to do your best to obtain the election of a Council that is pledged to economy.

Mr. Totty also addressed the Inspector in opposition to the application.

THE NEW GAS-WORKS AT COVENTRY.

The new Coventry Gas-Works at Foleshill, which are now nearing completion, occupy a large area; 47 acres of ground being taken up. Of this, 40 acres lie on the Foleshill Road side of the main line of railway extending from Coventry to Nuneaton, and the remainder is on the Radford side. The capacity of the part at present nearing completion is 5¼ million cubic feet of gas per day; while the maximum output in winter is now about 3¾ million cubic feet daily. There are two gasholders on the Radford side of the railway line, holding 3¾ million cubic feet. The ultimate capacity of the works for which space has been provided is about 15 million cubic feet per day. The cost of the present portion of the scheme runs to £200,000; and it was in January, 1903, that the first sod was cut. It is not intended during the coming winter to throw the whole of the strain of manufacturing gas upon the new works—a portion of what is required will be supplied from the old works. It is, however, hoped that the management will be able to close down the old works, so far as manufacturing is concerned, in the early spring of next year. The site will be utilized as a distributing station. The holders will remain; and the workshops will be used in connection with service-laying, gas-fitting, &c.

Last Thursday, the members of the City Council availed themselves of an opportunity of inspecting the new works. They journeyed in two special tramcars; and on arrival they were taken round by the Engineer and Manager, Mr. Fletcher W. Stevenson, who fully explained the system of manufacture and the details connected with the works. Subsequently they were entertained to tea; and the Mayor (Alderman W. Lee) said that he believed all of them were filled with admiration and amazement at what they had seen. Councillor W. H. Batchelor, Chairman of the Gas Committee, remarked that the Committee thought it advisable the Council should visit the works before completion. Another reason was that they were anxious that the members of the Council should see how the ratepayers' money was being spent, and that they were trying to obtain a good return for it. They were approaching the completion of their borrowing powers. The Committee asked for a certain sum; but it was found, owing to the rapid growth of the city, that they had spent so much on mains, meters, &c., that they had to ask the Council to let them have more money. The Committee had the fullest confidence in the undertaking, and were thoroughly satisfied with all that was being done.

The matter of borrowing powers, referred to by Mr. Batchelor after the inspection of the works, had been previously mentioned in a report by the Gas Committee which was submitted to the Town Council last Tuesday. It was therein stated that the Town Clerk had reported to the Committee with respect to additional statutory powers required by the Gas Department, and particularly with regard to the unexhausted power contained in the Corporation (Gas Purchase) Act, 1884, to borrow, with the sanction of the Local Government Board, further sums required for the purposes of the undertaking. It was resolved that Mr. Fletcher W. Stevenson be instructed to report upon the amount of money which will be required to complete the new works at Foleshill, and also for new mains and other purposes, so as to enable an application to be made to the Local Government Board for the necessary sanction. The Committee also resolved that the additional statutory powers required be sought by means of a Provisional Order amending the Coventry Corporation Gas Acts, 1856 to 1898, instead of by a Bill, as formerly proposed.

A SPIRAL GASHOLDER AT SOUTHBANK.

Last Friday morning Mrs. William Nixon, of Southbank, turned the gas into a new three-lift holder on the works of the Southbank and Normanby Gas Company, Limited.

The holder has been constructed on the spiral-guided system by Messrs. Robert Dempster and Sons, Limited, of Elland. It is fitted with their patented guide-rails and plates, and will be quite a landmark in the immediate vicinity. The holder is contained in a steel tank, 100 feet in diameter and 25 ft. 6 in. deep, which is entirely above ground; and when the three lifts are inflated, the structure will be about 100 feet in height. It contains 500,000 cubic feet of gas, which will be carried through pipes of 18 inches diameter from a new station meter. The tank is a fine massive structure, and has been riveted throughout by hydraulic power. The work (which reflects the highest credit upon Messrs. Dempster and Sons) has been carried out under the superintendence of Mr. William Nixon, the Engineer and Manager to the Gas Company, and by Mr. W. F. Smithers and Mr. Albert G. Jeynes, of Middlesbrough, as Consulting and Inspecting Engineers. The new station meter has a capacity of 30,000 cubic feet per hour, and was supplied by Messrs. Parkinson and W. & B. Cowan, Limited.

RENEWALS AT HEREFORD.

Capital or Revenue Charge.

The Hereford Town Council being desirous of borrowing £2000 for renewals in connection with the gas undertaking, a Local Government Board inquiry was held last Thursday by Mr. H. A. Reed, when the question of whether such work as was contemplated should be made a capital or revenue charge was gone into at length. The Deputy Town Clerk (Mr. Wilfrid Carless), who appeared in support of the inquiry, stated that the Council had borrowed for the gas-works sums amounting to £128,050, of which £95,660 had been repaid; leaving £32,390 outstanding. They paid £55,000 for the old gas-works in 1872, and had since removed to a new site. Mr. John Moore, solicitor, opposed the application on behalf of certain ratepayers; and Councillor Richard Moore also opposed, on the ground that such repairs and renewals ought really to be borne out of revenue, by the provision of a depreciation fund.

The Manager (Mr. W. W. Townsend) stated that the Council had decided to expend £1000 in the purchase and erection of 640 new lamps and frogs, in place of old lamps, owing to the fact that out of the 755 public gas-lamps, 109 were modern ones, erected within the last few years, and the remainder were very old and of an obsolete type, not at all suitable for the system of incandescent lighting adopted in the city. They were neither wind proof nor insect proof; and the joints being soldered, the intense heat from the incandescent burners melted off the taps—the result being that the cost of maintenance and repair was very heavy, while the lighting effect was not as good as in properly-designed lamps. The lamps also were not rain proof; the rain getting in through the top. The amount spent on repairs and maintenance of public lamps last year averaged 9s. per lamp, including mantles and chimneys. With new lamps the cost should not be more than 4s. each per annum. It was originally intended to replace the old lamps at the rate of 100 per annum; but it was found that considerable advantage could be obtained by buying all the lamps at once, as the price of copper was very low. The estimated cost of providing 640 new lamps made of copper throughout, and riveted, with wrought-iron frogs for attaching to the lamp-post, including the cost of erection, was 30s. each, which amounted to £960; and it was estimated that a further sum of £40 would be required for contingencies, and for extra cost of bracket lamps, &c. The new lamps would have porcelain reflectors, which were better than enamel. The Committee had bought 500 from Messrs. Pontifex and Co. Then £640 was the estimated cost of repairs to two gasholders, each with a capacity of 300,000 cubic feet, which were erected in 1880 and 1883 respectively, and which had both been found to be leaking. The Committee had been bound to repair one already, because the gas was escaping. This work had cost £224, and was not yet paid for. It had included repairs inside, the need for which could not be known until the holder was empty. He could not say what the other would cost to repair, and therefore thought it better to have a margin. A sum of £160 was required for paving the courtyard, which was previously in asphalt. This had been broken up by traction engines and hot coke being put upon it. Then £200 was needed for the renewal of a railway siding, 125 yards in length, which ran from the works gate to the coal-stores. As to the gasholders, the reasons of the Council why the proposed expenditure should be made out of capital, and not out of revenue, were as follows: (1) The capital borrowed for the erection of the holders was nearly paid off; (2) the outstanding capital on the gas undertaking was very low in proportion to the amount of gas sold; (3) a charge of £640 against the revenue in one year, in addition to the ordinary charges for repairs, which were already very heavy, would, in conjunction with the present high price of coal, probably necessitate an increase in the price of gas, and this the Council desired to avoid. The erection of the new lamps would effect a saving of £150 a year in maintenance, which now cost about 9s. per lamp. The last loan for lamps had been paid off about ten years ago.

Mr. John Moore remarked that he represented a small section of ratepayers with a rateable value of £1000, occupying and owning properties in the west end of the city—the majority of them on the Canon Pyon Road. His instructions were that the ratepayers to whom he referred had memorialized the Lighting Committee asking them to erect four or five, or perhaps half-a-dozen, street-lamps on this length of main road; and the answer of the Committee was that they could not see their way to do it. He took it that the only reason for the refusal was the ground of expense; but if the expense was so prohibitive, he submitted that the Corporation had no right to go to the outlay of £1000 on new street-lamps in a restricted area. The gas consumers on the main which had been extended along the road in question were contributing equally with other ratepayers in the city to the general rates, and also to the improvement fund, which took the place of a city rate.

The Chairman of the Gas Committee (Alderman C. Witts) said that personally he would not object to the lighting of the road—in fact, he would rather welcome it. But when he considered the question of benefit to the ratepayers, it was another matter, because there were only four houses in the road.

Councillor Richard Moore pointed out that the road was a main road leading from the city to the suburb of Huntington; and the farmers wished to have it lighted. There was, however, another point about the loan. He was himself a large ratepayer and owner of property in the city, and therefore did not want to say or do anything to injure it. But he did contend, and had done so ever since he had been a member of the Town Council, that the finances of the city should be put on a proper basis. In regard to this loan, no application ought to have been made at all, inasmuch as the whole of the expenditure was outlay which ought to have been paid out of revenue. They were repairs and renewals which should be borne annually and paid for annually as they arose. There was a depreciation fund in every well-regulated company; and there should be a reserve fund in this case. The Corporation were now paying off debts with one hand, and piling them up with the other; and he hoped the Inspector would lay the point before the proper authority that the loan should be refused simply and solely on the ground that it was for repairs and renewals which ought not to be capital expenditure.

Mr. Carless, in reply, said that the Council regarded such expenditure, which was in effect a partial renewal of plant on which the original capital had been nearly all repaid, as a proper charge against capital. The Corporation felt that the present consumers of gas had in the past been charged a high price in order to pay off the capital on the undertaking; and they did not consider it equitable that the consumers should now have to pay more for their gas in order that the plant for which they had paid once should be renewed year by year.

CHARGE FOR PUBLIC LIGHTING AT MALVERN.

The Question of Income-Tax.

In last week's "JOURNAL," reference was made to the financial position of Malvern, as disclosed by the District Auditor, Mr. Edward Stevens, in his report to the Council; and it was stated that in the course of this document he criticized the policy of the Council in charging themselves with full, instead of cost, price for gas for public lighting, &c., as involving payment of income-tax on profits not earned. Mr. Stevens's remarks on this subject are as follows: "The price credited to the gas account used by the Council appears to be too high. The price charged is at the rate of 2s. 10d. per 1000 feet. I consider that a charge of 1s. 6d. would be about the proper rate. The gas account as at present kept shows a very considerable profit, upon which profit it is to be noted that income-tax has to be paid. It will be admitted on all hands that the Council cannot make a profit out of themselves. The profit, if any, is the cash profit made by the Council in their dealing with the outside public, after all charges have been paid. The charges to the account necessarily include financial charges. The object of the Council should be to leave undisturbed this cash profit made from outside consumers. How then is the account affected by the fact that the Council use their own productions? This will be found to be chiefly under two headings—labour and material. The amount charged, therefore, and credited to this account should represent the additional cost of labour and materials occasioned by the Council's use of their own productions. The same reasoning will apply to the water and electricity accounts. I feel sure the Council will see the undesirability of any undue inflation of a profit balance, which paper balance benefits the ratepayers not one penny piece; and at the same time they will also see the practical objection to paying income-tax on any profit not actually earned."

Prior to the present Engineer and Manager (Mr. W. J. Rendell Baker) taking up his appointment at Malvern, all the gas used for public lighting and other Council purposes was charged at 3s. 4d. per 1000 cubic feet, and not at 2s. 10d. It may be mentioned that the gross profit of the undertaking for the year just ended was £10,686; and after paying principal and interest to the extent of £7917, the net profit which has been allocated to relief of rates was £2769. It is also interesting to note that during the year all extensions, &c., have been paid for out of revenue; and therefore no loan has been taken up.

CHAIRMAN OF GOOLE URBAN COUNCIL RESIGNS.

Delay in Rendering Accounts for Work Done.

At the Monthly Meeting of the Goole Urban District Council last Wednesday, the Clerk read the following letter from the Chairman (Mr. John Fawbert): "The Gas and Water Committee have had before them a report of the present Manager (Mr. W. A. Burton) as to shortage of stock in the Gas and Water Department. The Committee, after fully investigating the matter, have found there is no evidence of an intention to defraud the Council, or of collusion between me and the late officials, whereby goods and material should not be charged for. I cannot but feel that my tenure of the position of Chairman is made difficult by my being included in the inquiry, though I have been exonerated from any dishonest intention; and I feel that I am justified in herewith resigning the position of Chairman and my seat as a member of the Council."

Mr. Timm demanded that, through the Press, the public should know what had been going on, and what was wrong. He wanted a straightforward statement of the facts. A Local Government Board inquiry was really what he desired. Mr. Baker remarked that there had been negligence in the management; and it was in consequence

of this that the Chairman tendered his resignation. The amount due was somewhere about £10. After some further desultory remarks, the resignation was accepted.

In explanation of the position of affairs, the "Hull News" publishes the following extracts from the minutes of the Gas and Water Committee: On Aug. 25, the Clerk submitted the report of the Gas-Works Investigation Sub-Committee, when the detailed evidence obtained by the Sub-Committee was read for the information of the Committee. After a long discussion, it was ultimately resolved that a special meeting of the Gas and Water Committee, to decide what action should be taken in regard to the matter, be fixed for Sept. 1, and that the Clerk be authorized and instructed to communicate with the late Manager (Mr. T. E. Franklin). Following this was a meeting on Sept. 1, when the late Gas and Water Manager attended before the Committee as desired, to give a personal explanation of the alleged irregularities in the Gas-Works Department. It was resolved that the report of the Gas-Works Investigation Sub-Committee be read for the information of the Committee. The Clerk then read the report of the Gas-Works Investigation Sub-Committee, and the detailed evidence as obtained by them, when the late Manager fully replied thereto. Inquiries were addressed to him by members of the Committee, and certain witnesses who had given evidence before the Sub-Committee were again interviewed; and after a long discussion it was resolved that the meeting stand adjourned until Sept. 2. At the meeting held on the 2nd inst., it was resolved that the Committee, having fully considered the leakage in the stock accounts, and also the statements of persons implicated, considered that there had been irregularities in the manner in which goods had been taken out of stock, and in the charges for work done, as well as great laxity in the system of keeping the books at the gas-works. There did not, however, appear to be evidence of an intention on the part of any person to defraud the Council, nor was any proof found of collusion on the part of any late officials of the Council with a member of the Council with the intent that work done and material supplied should not be charged for. The Committee also considered that there had been neglect and delay on the part of the said officials to render accounts for such work done. The Committee therefore recommended to the Council that accounts be immediately rendered for all work done and materials supplied, and settlement made forthwith; and that in future all returns of the stock and stores account should be laid before the Gas and Water Committee on the presentation of the annual balance-sheet in connection with the department, and that the workmen's work-books for work done be checked and posted each day.

Reduction in Price at Ashford.—The Ashford Urban District Council have decided to reduce the price of gas at the end of the present quarter from 3s. 6d. to 3s. 4d. per 1000 cubic feet. They have also determined that in future gas-mains shall be laid at the public expense in new roads and streets, on a satisfactory guarantee of consumption being obtained from owners of property.

ACCRINGTON WATER BOARD'S EXTENSIONS.

A few days ago, the formal opening ceremony was performed at the Accrington District Gas and Water Board's pumping-station at Altham, which had cost about £30,000, and will provide a practically inexhaustible supply of pure water at the rate of about 1½ million gallons a day. The works, including engine-house, boiler-house, coal-store, and residence for the official in charge, are situated near the highway contiguous to the River Calder. A pipe-line to deliver the water has been carried across the bridge over the Calder, and is taken through Altham and Huncoat over the canal to the Burnley Road reservoirs. Mr. D. C. Dewhurst opened the door of the engine-house with a gold key bearing the following inscription: "Presented to Councillor D. C. Dewhurst, Chairman of the Accrington District Gas and Water Board, by the Engineers, Messrs. W. B. & B. W. Bryan." The members of the Board also presented Mr. Dewhurst with a memento, in the shape of a medallion, on one side of which was the crest of the Accrington District Gas and Water Board and representations of a gasholder and fountain, and on the other the inscription: "Presented to Councillor D. C. Dewhurst, Chairman of the Board, on the opening of Altham Pumping-Station."

In the course of the proceedings, Mr. W. B. Bryan, after regretting the absence of his son, Mr. Bernard Bryan, who had designed the pumping machinery, said since his first connection with the Accrington water-works in 1879, when the population supplied was 50,000, the population had increased to between 85,000 and 90,000. When the Board took over the works, there were no filter-beds, and no thoroughly adequate means of supplying the high levels. The new filters at Cliffe and the reservoir at Smalley Thorn were opened in June, 1899, and had been in continuous operation since, to the satisfaction of the Board and the inhabitants. Filters were subsequently constructed at Mitchells. These works, however, though improving the quality of the water, did not add to the quantity; and the Board were confronted with the very serious difficulty of providing more water for the increasing population. In Lancashire, the difficulties of obtaining additional supplies from the moors were almost insuperable; every drop of water practically being earmarked either for public supplies or industrial purposes. Therefore any abstraction for public purposes would involve enormous expenditure in constructing compensation reservoirs, besides a long and expensive fight in Parliament. For years the Board anxiously considered this question; and schemes for obtaining auxiliary supplies were gone into. There were difficulties in every case; and he might now say, in view of the day's proceedings, fortunately so. During all this period, by the unceasing efforts of Mr. Charles Harrison, the General Manager, the waste of water either from mains or services had been kept down; and though the supply was constant and at high pressure, the consumption was exceedingly modest. Useless waste meant more expenditure on capital account eventually, and in addition more water to deal with at the sewage outfalls. Some six years ago, the

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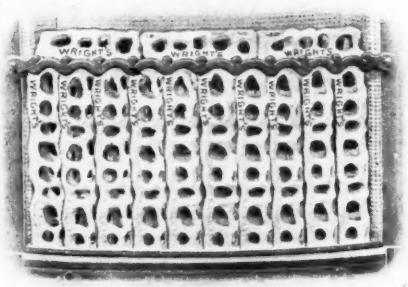

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firm of Hargreaves and Co. commenced sinking a colliery shaft; and in so doing met with such large quantities of water as to impede the progress of their works. This fact was brought to the knowledge of Mr. A. H. Aitken (the Clerk to the Board) and Mr. Harrison, and of the Board; and about five years ago he (Mr. Bryan) went down the shaft and examined the whole of the works, and had samples of the water taken for analysis. The reports of the analyst were in each case that it was an exceptionally good water. The pumping carried out by Messrs. Hargreaves extended over a very considerable period; and there appeared no doubts as to the permanent yield being very large. Eventually the Board entered into negotiations with Messrs. Hargreaves, obtained an Act of Parliament, and then constructed the present works. There were a number of difficulties of a novel nature to encounter. The adjoining shaft of the colliery had to be tubed with iron to keep out the water. It was therefore absolutely necessary to so construct the well that no water should be allowed to pass down into the strata below the tubing, or so that no water should gain access to the colliery, the shaft of which was 850 feet below the bottom of the Board's well. This, however, had been done under the able supervision of Mr. Millward, to whom they all owed a debt of gratitude for the manner in which the operations had been carried out. The sinking of a shaft would have been enormously costly; and after much deliberation it was decided that two large boreholes, commencing at 44 inches diameter, should be put down and lined with steel tubes. These holes extended to a depth of about 170 feet from the surface of the ground, and ended in a thick water-tight bed of shale. This work was executed by Messrs. Mather and Platt, of Manchester. The tests of the yield of water made by the firm were very satisfactory, and had since been amply confirmed. The engines, pumps, and other machinery, were erected by Messrs. Ashton, Frost, and Co., of Blackburn. The engine cylinders were 25 and 50 inches diameter by 4·6 inches stroke. The deep-well pumps were 18 inches diameter by 3·4 inches stroke. The force pumps were 15⅝ inches diameter by 4·6 inches stroke. The water could be delivered into either of the Burnley Road reservoirs—the upper one being about 400 feet higher than the engine-house. Running at 15 revolutions, the engine would force 1½ million gallons a day into the reservoirs. When the Board's storage reservoirs were full, pumping at Altham need not go on; but the great advantage of the pumping-station was that it could always allow of the storage in the reservoirs being kept to maximum capacity. When pumping stopped, the great underground reservoir automatically began to fill up again. It was now hoped that the new works would suffice the district for many generations to come. The boilers, superheaters, and pipe across the River Calder were executed by Messrs. Anderton and Sons. The engine-house, boiler-house, and chimney were erected by Messrs. George Cunliffe and Sons, from the designs of Messrs. Haywood and Harrison, who had been associated with them in this scheme.

Several streets and lanes of Castleton were lighted with gas for the first time on Monday of last week. Oil-lamps were previously used.

NOTES FROM SCOTLAND.

From Our Own Correspondent. *Saturday.*

In the Aberdeen Town Council on Monday, Mr. Stewart, the Convener of the Gas Committee, submitted the gas accounts for the year, a summary of which was given in these Notes last week. He said that the working of the Gas Department for the year might be summed up in a couple of sentences. The year started with an estimated deficiency of £1756; it ended with a favourable balance of £2787, or a gain upon the estimates for the year's working of £4543. While coal had cost 2s. 1d. per ton more than in the preceding year, the price of gas had not been increased. They had before them in the printed accounts issued by the City Chamberlain a very clear statement of how matters stood at the gas-works; and the Council must be satisfied and gratified with the results of the year's working. He did not intend to examine in detail the various accounts, but should only make mention of a few of the outstanding figures. The total revenue for the twelve months was £121,184—an increase of £8562. This represented a manufacture of 781 million cubic feet—an increase of 65 millions, which was double the increase of any previous year. Despite the depression in the city and the amount of unlet property, their consumers continued to increase; the number standing now at 32,177. The popularity of the slot meter was shown by an increase of 800. The total expenditure was £105,950—a very considerable increase over former years. This was almost altogether accounted for by the higher price of coal, which during the year averaged 17s. 6¾d. per ton, compared with 15s. 5¼d. the previous year, and 15s. 0¼d. in the twelve months preceding. As they had used 76,000 tons of coal, it would at once be seen why an increase must obtain. This increased expenditure would have been still greater had not their Engineer and his staff been able to introduce economies in the working of the various departments. The cost of purifying the gas had been reduced by nearly one-half; while in the manufacture of the gas itself—although the output had been increased by 65 millions—the works cost had remained unchanged. The year's operations had resulted in a balance of £15,720 being carried to the net revenue account. They started the year with a balance in hand of £6386, and they only carried forward a sum of £2787; but bearing in mind that they paid £11,000 more for coal, and did not increase the price of gas, this was much better than their anticipations. The total capital expenditure had been £355,143—an addition during the year of only £5000, a considerable portion of which was in connection with the new carburetted water-gas plant now in course of erection. The loans and mortgages were down £7000; the contingent sinking funds were up £10,000; and the reserve and the insurance funds had been increased by £1600. The revenue for the current year was estimated at £116,849, and the expenditure at £120,285, *plus* the surplus carried forward of £2787; leaving an estimated deficiency of £649. Owing to the fall in the price of coal—though they had not yet reached the old rates—there was no proposal

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DAVIS—the Gas Stove People.

CAMBERWELL, LONDON, S.E.

to increase the price of Aberdeen gas; and it said much for the efficient management of their establishment that, while other cities in the south had had to increase their charges, they in Aberdeen had been able to tide over the coal crisis without adding anything to the burden of their consumers. He moved the adoption of the accounts. Lord Provost Sir Alex. Lyon, in seconding, congratulated the Convener on his statement. It was the first time for many years that he had not heard the voice of his friend Mr. Kemp on the gas budget: but he was sure he would be glad to see that he was succeeded by so able a Convener, for they all recognized in Mr. Stewart an admirable successor to Mr. Kemp. He added the congratulations of the Council to Mr. Stewart that he was in the position of not having to raise the price of gas, and that he was able to follow up what he did last year, when there was no increase. The accounts were adopted.

The Tayport Town Council, at a special meeting held last night, unanimously resolved to adopt the Burghs Gas Supply (Scotland) Act of 1876.

The Hamilton Town Council on Tuesday let contracts for the supplying of coal-handling plant for the gas-works. Messrs. W. J. Jenkins and Co., Limited, secured the contract for the stoking machinery, including two storage hoppers of 60 tons capacity each, at the price of £2937; and Messrs. Babcock and Wilcox, Limited, the contract for a coal elevator and gravity bucket conveyor, at the price of £2028.

It is reported that at a special meeting of the Wishaw Town Council on Wednesday, an abstract of the burgh accounts for the past year, as audited, was submitted, and that considerable discussion took place in connection with the gas account, which showed a loss on the year's working of £556, notwithstanding that the price of gas was raised 6d. last year, making the cost to the consumer 2s. 11d. per 1000 cubic feet. As the Gas Department has also to bear any loss there may be in the Electric Lighting Department, which shows a deficit of nearly £900, it was stated that an additional 5d. would probably require to be put on the price of gas, raising it to 3s. 4d. per 1000 cubic feet. The Gas Convener was of opinion that something was wrong; and he declined to approve of the accounts as audited until he had examined them for himself. Consideration of the accounts was accordingly adjourned.

The Denny Gas Committee on Tuesday, reported that after resumed consideration of the subject they were of opinion: (1) That, in order to provide a depreciation and renewal fund to maintain the gas-works in perpetuity, it was necessary to set aside annually (in addition to the depreciation for meters, stoves,, &c.), a sum equal to 1 per cent. on the value of the gas-works and land, under deduction of surplus assets, as appearing from time to time in the statement of assets and liabilities—being at the 15th of May last £11,763 less £4007, which leaves £7776, the depreciation on which, at 1 per cent., would amount to £77; (2) that by setting aside this sum a deficiency to the extent of about £60 would be created; that, as indicated in the Committee's previous report, it would not be advisable to attempt to provide for that deficiency by raising the price of gas, as, in the opinion of the Committee, this would have the effect of reducing the consumption of gas, and causing a serious and permanent loss to the undertaking; and (4) that the Committee, after making inquiry, were of opinion that it was competent to impose a gas contingent guarantee rate to meet the estimated deficiency, and they recommended the imposition of a rate of 1d. in the pound to meet the same. The Council adopted the recommendation.

I have received from Mr. John R. Moyes, the Hon. Secretary and Treasurer of the Eastern District of the Scottish Junior Gas Association, a copy of the Report of Proceedings of the Association during the past session. The book is a reprint of the reports which appeared in the "JOURNAL." It extends to forty pages, and contains, besides the report, lists of office-bearers and members, and the balance-sheet, from which it is to be observed the Association have now a balance in hand of £12. Copies are to be supplied to the members at the nominal charge of 1s. each.

Speaking to the gas minutes in the Dumfries Town Council, Bailie Thomson, the Convener of the Gas Committee, said that if they could possibly have lowered the price of gas by 2d. they would have done so; but it so happened that the fall in the price of coal had not been anything like what took place when the coal was raised about twelve months ago, so they were not able to reduce it. They had a large sum put by in reserve, and this would be pretty fully drawn upon during the present year. Twenty-five years ago, the capital debt upon the gas-works was about £25,000; and at that time they were manufacturing about 25 million cubic feet of gas per annum. At present they were making some 100 million feet; and the total amount of debt upon the gas-works was about £28,000. There was every reason to be satisfied that the gas-works were in the very best condition; and he thought the community should be proud of them.

In the Town Council of Newport (Fife) on Monday, Mr. Leitch said that the accounts of the Gas Department compared favourably with those of the preceding year, although, owing to dear coal, the net revenue account showed a slight falling off from what was anticipated. Nevertheless, the result was highly creditable. The sale of gas had increased by about 330,000 cubic feet; and the quantity of coal carbonized had risen from 1876 to 1926 tons. There had also been an increase of £89 from the sale of residual products; while the number of gas-cookers in use showed gratifying results. The net revenue account showed a credit balance of £492, from which £250 would be transferred to the general reserve fund account, raising the special reserve fund to £750. It was anticipated that after the new sulphate of ammonia plant was installed there should be a material saving shown in the cost of gas manufacture. Although favouring the abolition of meter and stove rents, the Council thought it inexpedient as yet to dispense with these sources of revenue; but hopes of a reduction in the price of gas might be entertained. It was decided to continue the price of gas at 3s. 10d. per 1000 cubic feet. The salary of the Manager—Mr. John F. Black—was increased by £10.

I mentioned a few months ago a case of suffocation by gas in Alloa, in which two boys, aged ten and eight years respectively, the sons of

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LEST YE FORGET.

Mr. Cunningham, lost their lives. A heavy claim for compensation in respect of the deaths of the boys was made against the Alloa Town Council by their father; the liability sought to be established being that coal gas found its way into the house occupied by the Cunningham family from a service-pipe in the street, which had been damaged by workmen in the employment of the Corporation, who had been engaged the previous day in laying a street-main. The Corporation, while admitting liability to some extent, considered the claim excessive; but opened negotiations for a settlement, which have been successful. Juries are sympathetic, and such cases when they go to trial almost invariably end in a verdict for the pursuer, when, of course, to the award have to be added the costs of the action. It is therefore cheaper to pay than to defend. In this case, the expenses would have amounted to not less than £300, and for this sum the Corporation have been able to effect a settlement in full of the claim; each boy being found entitled to a sum of £150.

In Johnstone last year, out of an output of gas amounting to nearly 80 million cubic feet, as much as 14 millions were sold through prepayment meters, and 800,000 cubic feet for gas-engines. The price of gas for lighting and cooking purposes has been reduced from 2s. 6d. to 2s. 4½d., and for motive power from 2s. 4d. to 2s. 2½d.

The Corporation of Ladybank, in Fifeshire, some time ago, on the instruction of the Local Government Board, introduced a drainage system into the burgh, at a cost of £4000. Following up that service, they have now completed a new system of water supply, at a cost of £6000. The water, drawn from an artesian well, is pumped by a windmill and an oil-engine into tanks upon the top of a tower 90 feet high. There is a supply of 130,000 gallons per twenty-four hours, which is ample for the community. The new system was inaugurated on the afternoon of Saturday, the 5th inst.; the water being turned on by Mrs. Crichton, the wife of the Provost of the place.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Sept.* 12.

Sulphate of Ammonia.

There has been further buying; but supplies have been more plentiful, and prices have barely been maintained. Prices have, in fact, been rather irregular, but the closing quotations are £11 5s. per ton f.o.b. Hull, £11 7s. 6d. to £11 8s. 9d. per ton f.o.b. Liverpool, and £11 11s. 3d. to £11 12s. 6d. per ton f.o.b. Leith. The forward position has been neglected, so that makers' quotations, which are unchanged, must be regarded as mainly nominal.

Nitrate of Soda.

This is weak in all positions. The closing spot quotations are 10s. and 10s. 3d. per cwt. for 95 per cent. and refined qualities respectively.

LONDON, *Sept.* 14.

Tar Products.

There is nothing of importance to record in the markets for tar products this week. Makers are asking higher prices for pitch; but business cannot be done at their figures. Creosote is still very firm; and there is not very much oil offering. Benzol is weak; but a little business is reported in toluol. Carbolic acid is without interest and no sales of importance are reported.

The average values during the week were: Pitch, London, 18s.; east coast, 17s. 6d. to 18s.; west coast, 16s. 6d. to 17s. 6d., f.a.s. Benzol, 90 per cent., casks included, London, 7d. to 7¼d.; North, 6¾d. to 6¾d.; 50-90 per cent., casks included, London, 7d. to 7¼d.; North, 6¾d. to 7d. Toluol, casks included, London, 7½d. to 7⅝d.; North, 7d. to 7¼d. Crude naphtha, in bulk, London, 3¼d. to 3⅜d.; North, 3d. to 3⅛d.; solvent naphtha, casks included, London, 10d. to 10¼d.; North, 9d. to 9¼d.; heavy naphtha, casks included, London, 9⅜d. to 10⅛d.; North, 8⅜d. to 9¼d. Creosote, London, 2⅝d. to 2⅞d.; North, 2⅜d. to 2⅝d. Heavy oils, in bulk, 2⅞d. to 3d. Carbolic acid, 60 per cent., casks included, east coast, 1s. 2d. to 1s. 3d.; west coast, 1s. 2d. to 1s. 2½d. Naphthalene, £4 10s. to £8 10s.; salts, 35s. to 37s. 6d., packages included and f.o.b. Anthracene, "A" quality, 1½d. to 1⅝d. per unit, packages included as well as delivered.

Sulphate of Ammonia.

Although there has been no material change in prices, the market is inclined to be a little weaker. The principal London Gas Companies quote £11 17s. 6d. this year, and outside makes £11 7s. 6d. to £11 8s. 9d. for the same period. In Hull, £11 6s. 3d. is quoted, and in Liverpool £11 8s. 9d. In Leith, £11 12s. 6d. is reported for delivery this year and £12 for January-June.

COAL TRADE REPORTS.

Northern Coal Trade.

In the Northern coal trade, steam qualities have shown some tendency towards lower prices; while gas coals have been firm. Best Northumbrian steams are in good demand for early shipment; but there is weakness for forward supply. Prices range from about 13s. 9d. to 14s. per ton f.o.b. Second-class steams are from about 11s. 6d. to 12s. 6d., and steam smalls from 5s. 6d. to 6s. 6d. There is a steady production; and at the present time it is well taken up. In the gas coal trade, the demand is fair, and shows the steady growth which is usual at this season of the year. Durham gas coals vary from about 10s. 3d. to 11s. 6d. per ton f.o.b. for the ordinary classes, according to quality, and best "Wear" kinds are up to about 12s. There is not much doing in contracts at present; but some sales for delivery over next year to Mediterranean ports have been made at a little below the values for prompt delivery. A quantity is believed to have been sold at about 10s. per ton; but the rates of freight outward are rather high,

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and this influences the amount left at the pit. In the coke trade, there is steadiness; and though gas coke is now rather more plentiful, the price is at from about 15s. 6d. to 16s. 3d. per ton f.o.b. for good descriptions.

Scotch Coal Trade.

Trade continues upon the same lines as it has for some weeks; the principal variation being that a scarcity of freightage is threatening to interfere with the export trade—of course, only for the immediate present. There is, generally, a good demand for all except small sorts. The prices quoted are: Ell 10s. 6d. to 12s. 6d. per ton f.o.b. Glasgow, splint 11s. to 11s. 3d., and steam 10s. 3d. to 10s. 6d. The shipments for the week amounted to 331,313 tons—an increase upon the preceding week of 18,677 tons, and upon the corresponding week of 6990 tons. For the year to date, the total shipments have been 9,637,919 tons—a decrease upon the corresponding period of 414,008 tons.

NEW CATALOGUES.

A new catalogue has been issued by Messrs. Green and Boulding, Limited, of No. 28, New Bridge Street, E.C., in which will be found full particulars of the "Buffalo" injector, the "Tripp" metallic packing, and the "Star" engine indicators and renewable-seat valves, as well as of other specialities.

Messrs. S. P. Catterson and Sons, of Newington Causeway, S.E., forward a supplement to their gas-fittings catalogue, 1907-8, which contains revised prices and particulars of additions to stock. Among other things, there is illustrated a large selection of inverted and upright indoor and outdoor gas-lights; and there are also many patterns of globes shown.

We have received from the Provincial Incandescent Fittings Company, Limited ("Pifco"), a copy of the "Provincial" official A.B.C. guide on lighting by gas railways, streets, hotels, shops, factories, and residences on the most approved methods. It contains full particulars of the goods which the Company are prepared to supply—mantles, burners, globes, accessories, and fittings—including the Block lights, the patents, &c., for which they have recently acquired.

The Pneumatic Gas Lighting Company, Limited, of No. 36, Farringdon Street, E.C., have issued a new catalogue relating to their pneumatic distance gas-lighter and accessories. Particulars are given of many additions and improvements that have been made to the system; and in this respect special attention may be drawn to a new series of valves for high-pressure lamps of all descriptions. There is a special valve made to fit the three sizes of Welsbach self-intensifying lamps; and there are also valves for petrol, acetylene, and flat-flame coal-gas burners. Strong testimony to the popularity of the Company's system is furnished by the long list of the latest and most important installations carried out, which is incorporated with the catalogue.

Suicide by Gas at Cardiff.—Thomas Murley, who lived by himself in Cardiff, was last Thursday evening discovered dead in his bathroom, suffocated by gas. The bath was full of bedclothes, on which the body was lying; and in his hand deceased held the end of a length of pipe, which was attached to a gas-jet, turned on full. The door of the bathroom was shut. The man had been much depressed since the death of his wife. At the inquest, a verdict of "Suicide while of unsound mind" was returned.

Gas Explosion in Manchester.—A gas explosion occurred at a clothier's shop in Rochdale Road, Manchester, last Tuesday, which unfortunately resulted in personal injuries to three men. Mr. Barrett, the tenant, on arriving at the shop in the morning, with his assistant, noticed a smell of gas. A leakage in a pipe was found; and the aperture was filled with soap. Then, forgetful of the fact that the gas had been accumulating in the shop all night, a match was struck, which caused the explosion. The shop window was blown out; and Mr. Barrett and his assistant were badly scorched about the hands and head. A man who was passing the window had his ear badly cut and his hand injured. Mr. Barrett and the assistant were removed to the infirmary, where the former was detained.

Serious Explosion at the Milan (San Celso) Gas-Works.—On the morning of the 2nd inst., at the Milan (San Celso) Gas-Works of the Union des Gaz Company, a serious explosion occurred in the purifier-house. The reports in the Milan newspapers are not too clear or precise; but it appears that the explosion arose while changing an oxide purifier containing about 150 cubic metres of oxide. Such explosions—through heated purifying material in the boxes and insufficient precautions—are not, of course, unknown. There was a loud report, which startled the whole works, and fire-engines were sent for, as it was feared that danger by fire might follow the explosion. It was found that four workmen, who had been attending to the purifier-box, were injured, and were taken to the hospital, where it was reported that one of the men was in a dying condition. An inquiry into the accident is to be held.

General Manager's Salary at Oldham.—The Oldham Town Council last Wednesday considered a Committee's recommendation that the salary of Mr. Arthur Andrew, the General Manager of the Gas and Water Departments, should be increased from £500 to £550 per annum. In moving a resolution to this effect, Alderman Johnson pointed out that Mr. Andrew had been with the Corporation 42 years, for 14 of which he had occupied the position of General Manager. He carried out all his work faithfully, and with the greatest possible ability. Mr. Greaves pointed to a resolution of the Council that all applications for advances should be made in February; and he said that the present recommendation of the joint meeting of the Gas and Water Committees was only carried by the casting vote of the Chairman. In the course of further discussion, Mr. Dronsfield remarked that he did not think they gave sufficient encouragement to their heads of departments. The resolution was, however, lost; only six members supporting it.

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Bexhill Water and Gas Company.—In the report to be presented at the meeting of the Company on the 29th inst., the Directors state that the accounts for the half year to June 30 show a balance at credit of profit and loss account available for dividend of £5534. They recommend that a dividend be declared for the six months at the rate of 7 per cent. per annum on the capital of £34,000 authorized by the Acts of 1885 and 1892, and at the rate of £4 18s. per cent. per annum on the capital of £104,570 authorized by the Act of 1896 and Order of 1901, less income-tax. This, with provision for income-tax, will absorb £3607; leaving £1927 to be carried forward to the next account. The Directors regret that the continued high price of gas coal has materially affected the profits for the half year. At the close of the ordinary meeting, an extraordinary meeting will be held at which resolutions will be submitted sanctioning the raising of additional capital by the creation of new ordinary shares and the issue of debenture stock.

A Foremen's Strike at the Union des Gaz Company's Milan Works.—About forty foremen and assistant foremen at the Milan Gas-Works abstained from their work on Saturday, the 5th inst. It appears that they had approached the Company with proposals asking that their pay should be increased, as it was not sufficiently high above the rates paid to the men under their charge, and that therefore their influence was slight and the good management of the works suffered. Signor Lacombe had to inform them that the Company could not accede to their demands; and they thereupon ceased work and sought the assistance of the men. But the Secretary of the Union (Signor Speroni) was not too eager to support them, as he thought the foremen, though justified in making their demands, had done so too precipitately, and without first consulting the Union, who ought therefore to keep outside the dispute. They were, however, to hold a meeting to consider their attitude; but, no doubt, the matter would very soon be settled, without disorganizing so important a public service as that of gas.

A Good Year at Keswick.—Presiding at the annual meeting of the Keswick Gas Company, the Chairman (Mr. E. Jackson) said that the past year's trading had been very satisfactory; the net profit amounting to £1305. This was a small diminution in profit of £58, as compared with the previous year, which, however, was not caused by any reduction in the quantity of gas made, as under this head there was an increase of 422,100 cubic feet. It was owing to the increased cost of coal of 2s. 6½d. per ton, which made a difference to the profit of about £240. The revenue obtained from the sale of residual products showed a slight increase. The renewal of mains had cost about the average amount; but the work done had materially lessened the leakage, which had been reduced from 8·13 per cent. to 6·6 per cent. This was a very small amount of waste; and the Manager (Mr. T. Heywood) deserved commendation thereon. The productive plant had been kept in good repair; but the time had arrived when some enlargement, duplication, and remodelling should be carried out, and work was now progressing which would make for economy and efficiency. The report and accounts were adopted, and dividends were declared of 10 per cent. on the original capital and 7 per cent. on the additional capital.

Worthing Gas Company.—The Directors of the Worthing Gas Company reported at the recent half-yearly meeting that there was a balance of funds of £14,876. The standard dividend of 5 per cent. was declared. The purchase of the new site at Goring and other capital expenditure had produced a debit balance on the capital account; but the raising of extra capital at a later date was amply provided for under the Company's enlarged borrowing powers.

Gas Profits at Stockport.—Under this heading in last week's issue of the "JOURNAL" (p. 663), some remarks were given by Mr. James Fernley, the Chairman of the Gas Committee, in the course of which he was made to state that last year "the quantity of coal carbonized was 56,034 tons; the gas made being 803,492,000 cubic feet." A correspondent has written calling attention to these figures, which he points out would mean a make of over 14,000 cubic feet of gas per ton of coal. The explanation of the matter is no doubt that the figures as they stand are incomplete, and that, in addition to the coal mentioned, a certain quantity of oil was used for the manufacture of carburetted water gas. Looking at the recently-issued Gas Undertakings Returns, we find that the figures given for Stockport—that is, be it noted, for the twelve months ending March 25, 1907 (not March 31, 1908, which was the period dealt with by Mr. Fernley)—are: Gas made: Coal gas, 593,570,000 cubic feet; water gas, 188,956,000 cubic feet; total, 782,526,000 cubic feet. Coal carbonized, 54,578 tons. Oil used, equivalent to 17,292 tons of coal.

North Warwickshire Water Company.—The Directors of the North Warwickshire Water Company, in the report which was adopted at the recent annual meeting, expressed regret that the revenue, though showing a small increase upon that of the previous year, had not realized expectations. The number of services on the Knowle extensions was, however, they stated, gradually increasing; and several large consumers had been obtained within the last few months. There was thus every prospect of considerable revenue being obtained from this district during the current year. Several profitable extensions had been carried out in other parts of the Company's district; but the full benefit of these had not yet been obtained. Referring to the Company's relations with the Coventry Corporation, he said last year they endeavoured to give the city a supply, and opposed the Corporation Water Bill in Parliament, because they thought Coventry was extravagantly spending a lot of money on a new supply when they had one at their own doors, obtainable at a considerably less outlay than they were involved in with the Birmingham Corporation. They had done their best, having pointed out to the authority the financial advantages of accepting the Company's supply; and they tried unsuccessfully to impress this view on the House of Commons Committee. It might be that yet, and before Coventry took a Welsh water supply, they would turn to their neighbours, and see if they could not make satisfactory terms with them. It had been found necessary to raise the further sum of £1000 by the issue of debentures in order to provide working capital. The revenue account showed water-rentals of £1543, out of a total revenue of £1636. The revenue account balance was £2172.

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Southend in Darkness.—Southend was plunged in darkness at eight o'clock on Saturday night through the electric light failing; and many parts of the borough were in darkness for a quarter-of-an-hour. At the Corporation's Cliff Bandstand all the electric lamps went out; and at the Empire Theatre a performance of "Maritana," by the Moody-Manners Opera Company was about to commence when the light failed. Gas was available at the Kursaal.

Bridport Water Company.—The net revenue of the Bridport Water Company for the half year to June 30 was £895; and the balance available for dividend was £844. This admitted of the full dividends on the 5 and 4½ per cent. preference shares; and the Directors in their report recommended the payment of a dividend of 4½ per cent. on the ordinary shares, leaving a balance of £146 to be carried forward. The gross revenue was £1244, and the expenditure £349. At the meeting of shareholders the report was adopted, and a dividend was declared as recommended.

Rochdale Coal Contracts.—The Rochdale Gas Committee, having considered the question of contracts for the supply of coal, have decided to purchase 45,000 tons at prices which average 7½d. per ton less than those of last year. This will mean on these contracts alone a saving of about £1400. But the 45,000 tons ordered does not represent the whole of the coal that will be required at the works during the twelve months, which is about 55,000 tons. The remainder will be bought later. The Committee also ordered 600 tons of oil for use in the carburetted water-gas plant; the price being slightly below that of last year.

Bankruptcy of an Inventor.—At the London Bankruptcy Court, on Monday of last week, the first meeting was held, before Mr. Daniel Williams, Assistant Official Receiver, of James Ernest Burrell, described as of Hestercombe Avenue, Fulham. It transpired that the debtor was for thirteen years a traveller, first for the Welsbach Incandescent Gaslight Company, and afterwards for Messrs. J. & W. B. Smith. He was the joint inventor of the "Kerridge" electric gas-controller and of the "Spreadbury" incandescent burner. The former was sold to the Welsbach Company for £400; but the debtor's share of the money did not cover his expenses. He only received £25 in respect of the latter; this sum also being insufficient to cover his expenses. The debtor attributed his failure to excess of expenditure over income, cost of models, and patent agents' fees. No statement of affairs was lodged; but the debtor roughly estimated his liabilities at £250 or £300, and he has no assets. The case was left in the hands of the Official Receiver to be wound up in bankruptcy.

Having considered the question of the purchase of the local gas-works, the Ripley Urban District Council have decided to ask the Company to state the terms on which they would be willing to dispose of their undertaking.

The United Chemical Works, Limited, again draw attention to the removal of their London offices to 79, Turnmill Street, Farringdon Road, E.C., where they are specially equipping show-rooms for incandescent gas lighting appliances.

At last Thursday's meeting of the Heywood Town Council, it was stated that by adopting a "waiting policy" in placing the contracts for 10,000 tons of coal, the Gas Committee had secured a reduction of 10¾d. per ton on last year's price.

The Fenton Urban District Council have decided to use for the public lighting the "Caxton" street lantern (fitted with the patent double anti-friction roller trap) manufactured by Mr. William Edgar, of Blenheim Works, Hammersmith.

An artesian well has been bored at the Ascot District Gas and Electric Company's works to a depth of over 500 feet, and the supply of water obtained is not less than 2000 gallons per hour. The work has been carried out by Messrs. Isler and Co.

The Stony Stratford Gas Company have placed an order with Messrs. Robert Dempster and Sons, Limited, of Elland, for remodelling their works, including new retort-bench, retort-house roof, washer, and purifiers. The work has to be carried out to plans prepared by Mr. G. S. Eunson, the Gas Company's Engineer.

An explosion and the heaving up of a considerable section of pavement, followed by large flames, occurred at Newcastle-on-Tyne last Tuesday. The fire brigade were summoned; but the water thrown on only produced black smoke without putting out the fire, and the electric cables had to be cut away some distance on either side. The flames burnt fiercely for over an hour.

The Newport (Isle of Wight) Town Council have authorized the purchase by the Water Committee of a 110-horse power gas-engine, and suction plant, capable of pumping 50,000 gallons of water per hour against a head of 255 feet. The existing pumping power has been found insufficient to cope with the supply; and an opinion was given that by the installation of the gas-engine a saving of fuel would be effected to the extent of £200 per annum.

At the last meeting of the Sowerby Bridge Urban District Council, Mr. Clay, in connection with the Finance Committee's minutes, pointed out that about 1867 a loan of £62,000 for the gas-works was negotiated; and included in the Committee's accounts that evening was a sum of £1500, which was the last repayment of the loan. It represented 7d. or 7½d. in the pound, so the Council were hoping to give the ratepayers some relief in the near future, either in the district rate or in the price of gas.

According to the "Ironmonger," the Directors of the Metropolitan Amalgamated Carriage and Waggon Company have decided to close their Lancaster works. The decision has been arrived at primarily because of the depression in trade, and secondarily because of the obstacles that are alleged to have been placed in the way of the development of the concern by the Lancaster Corporation and the Licensing Justices. The Corporation three or four years ago declined to supply gas for motive power except at what was considered an exorbitant charge; and the Licensing Justices in 1904 refused an application for a licence to the men's dining-rooms. Of late years the works have not been running at full strength, but at one time employed 2000 men.

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COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

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All Communications, Remittances, &c., to be addressed to WALTER KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.
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"ILLUMINATING TRUTHS."

LEAFLETS FOR DISTRIBUTION.

No. 1.—"The Sanitary Aspects of Gas and Electric Lighting."
No. 2.—"The Cleanliness of Illuminants: The Eyesight."
No. 3.—"Fire Risks."
No. 4.—"The Relative Cost of Gas and Electricity, and Matters affecting it."
No. 5.—"On Reliability, with Instances of Misplaced Confidence."
No. 6.—"On Shop Lighting, with Special Reference to the Flame Arc Lamp."
No. 7.—"The Osram Lamp: Fiction and Fact."

This series of Leaflets will be useful, not only for distribution among Householders generally, but for circulation among Shareholders to fortify them with arguments in defence of the commodity in which they have invested capital. Copies of each Leaflet should also be kept in every Gas Undertaking's Show-Rooms.

Prices for Quantities on Application to WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.
DRAUGHTSMAN. No. 4990.
SECRETARY (WORKING). Brentwood Gas Company.

Situation Wanted.
MANAGER OR ASSISTANT. No. 4988.

Correspondence Classes.
LEES, H., Hexham.

Plant (Second-Hand), for Sale.
GAS EXHAUSTER. John Adams and Sons, Newcastle.
RETORT BENCH MOUNTINGS, PIPES, &c. Lochgelly Gas Company.

Patents to Sell or Licences to Manufacture.
PRODUCTION OF OIL GAS. H. Gardner and Son, Fleet Street, E.C.

Meeting.
BRITISH GASLIGHT COMPANY. London Office. Sept. 30. Twelve o'clock.

TENDERS FOR

Coke.
COMMERCIAL GAS COMPANY. Tenders by Sept. 24.
SHEPPY GAS COMPANY. Tenders by Sept. 30.
WANDSWORTH AND PUTNEY GASLIGHT AND COKE COMPANY. Tenders by Sept. 18.

Lead and Compo. Pipe and Tin.
RHONDDA GAS AND WATER DEPARTMENT. Tenders by Sept. 22.

Meters.
GLASGOW GAS DEPARTMENT. Tenders by Sept. 22.
LIVERPOOL CORPORATION. Tenders by Sept. 30.

Oxide of Iron.
SALFORD GAS DEPARTMENT. Tenders by Sept. 24.

Sulphuric Acid.
LEICESTER CORPORATION. Tenders by Sept. 26.

Tar and Liquor.
BLACKPOOL GAS DEPARTMENT. Tenders by Sept. 25.
GRANTHAM GAS COMPANY. Tenders by Sept. 22.
SHIPLEY URBAN DISTRICT COUNCIL. Tenders by Sept. 21.

Venturi Water Meter.
BARNOLDSWICK GAS AND WATER DEPARTMENT.

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 701.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
590,000	10	Apl. 10	10	Alliance & Dublin 10 p.c.	19½–20½	..	4 17 6
268,324	10	,,	7	Do. 7 p.c.	13⅜–14½	..	4 16 6
310,000	Stk.	July 15	4	Do. 4 p.c. Deb.	99–102	..	3 18 5
200,000	5	May 29	6¼	Bombay, Ltd.	5⅞–6⅛	..	5 4 0
40,000	5	,,	6¼	Do. New, £4 paid	4–4½	..	5 15 7
50,000	10	Aug. 27	14	Bourne-mouth Gas and Water } 10 p.c.	28–29	..	4 16 6
51,810	10	,,	7	B 7 p.c.	16½–16⅞	+⅛	4 3 7
53,200	10	,,	6	Pref. 6 p.c.	15–16	..	3 15 0
380,000	Stk.	Aug. 13	12½	Brentford Consolidated	244–249	+1	5 0 5
300,000	,,	,,	9½	Do. New	181–186	..	5 2 2
50,000	,,	,,	5	Do. 5 p.c. Pref.	120–125	..	4 0 0
206,250	,,	June 12	4	Do. 4 p.c. Deb.	100–105	..	3 16 2
220,000	Stk.	Sep. 11	10⅔	Brighton & Hove Orig.	205–210*	+⅜	5 2 4
246,320	,,	,,	7⅛	Do. A. Ord. Stk.	150–155*	−⅛	5 0 0
460,000	20	Mch. 27	10	British	41–43	..	4 13 0
109,000	Stk.	Aug. 27	6	Bromley, Ord. 5 p.c.	113–116	..	5 3 5
165,700	,,	,,	4½	Do. do. 3½ p.c.	84–86	..	5 4 8
500,000	10	May 14	7	Buenos Ayres (New) Ltd.	11¼–11⅝	..	5 19 1
250,000	Stk.	June 26	4	Do. 4 p.c. Deb.	92–94	..	4 5 1
150,000	20	July 15	7½	Cagliari, Ltd.	24–25	..	5 16 0
100,000	10	—	—	Cape Town & Dis., Ltd.	4–6	..	—
100,000	10	Apl. 26	4½	Do. 4½ p.c Pref.	5–7	..	6 8 7
50,000	50	May 2	6	Do. 6 p.c. 1st Mort.	48–50	..	6 0 0
100,000	Stk.	June 26	4½	Do. 4½ p.c. Deb. Stk	78–83	..	5 8 5
157,150	Stk.	Aug. 13	5	Chester 5 p.c. Ord.	108½–110½	..	4 12 7
1,493,280	Stk.	Aug. 27	5⅛	Commercial 4 p.c Stk.	105–110	..	4 14 6
560,000	,,	,,	5	Do. 3½ p.c. do.	101–103	..	4 17 1
475,000	,,	June 26	3	Do. 3 p.c. Deb. Stk.	82–84	..	3 11 5
800,000	Stk.	June 12	6½	Continental Union, Ltd.	108–113	..	5 15 0
200,000	,,	,,	7	Do. 7 p.c. Pref.	137–142	..	4 18 7
460,170	Stk.	—	5	Derby Con. Stk.	122–124	..	4 0 8
55,000	,,	—	4	Do. Deb. Stk.	103–105	..	3 16 2
148,995	,,	Mch. 31	5	East Hull 5 p.c. Ord.	100–103	..	4 17 1
486,090	10	July 15	12	European, Ltd.	22½–23½	..	5 2 2
354,060	10	,,	12	Do. £7 10s. paid	16⅛–17⅛	..	5 2 10
15,182,590	Stk.	Aug. 13	4/10/8	Gas-light and Coke } 4 p.c. Ord.	99–101	+1	4 9 9
2,600,000	,,	,,	3½	3½ p.c. max.	87–89	..	3 18 8
3,799,735	,,	,,	4	4 p.c. Con. Pref.	104–107	..	3 14 9
4,193,975	,,	June 12	3	Coke } 3 p.c. Con. Deb.	85–87	..	3 8 11
258,740	Stk.	Sep. 11	4⅔	Hastings & St. L. 3½ p.c.	93–95*	+2⅜	4 16 11
82,500	,,	,,	6¼	Do. do. 5 p.c.	112–115*	+3⅜	5 8 8
70,000	10	Apl. 29	11	Hongkong & China, Ltd.	18–19	..	5 15 9
4,940,000	Stk.	May 14	8	Imperial Continental	180–182	..	4 7 11
473,600	Stk.	Aug. 13	3½	Do. 3½ p.c. Deb. Red.	94–96	..	3 12 11
195,242	Stk.	Aug. 27	6	Lea Bridge Ord. 5 p.c.	116–120	..	5 0 0
561,000	Stk.	Aug. 27	10	Liverpool United A	227–229	..	4 7 4
718,100	,,	,,	7	Do. B	164½–166½	..	4 4 1
306,083	,,	June 26	4	Do. Deb. Stk.	104–106	..	3 15 6
75,000	5	June 26	6	Malta & Medn., Ltd.	4¼–4⅝	..	6 6 4
560,000	100	Apl. 1	5	Met. of } 5 p.c. Deb.	101–103	..	4 17 1
250,000	100	,,	4½	Melbourne } 4½ p.c. Deb.	101–103	..	4 7 5
541,920	20	May 29	3½	Monte Video, Ltd.	11–12	..	5 16 8
1,775,892	Stk.	July 30	4/12/6	Newc'tle & G'tesh'd Con.	107–108	..	4 5 8
418,460	Stk.	June 26	3½	Do. 3½ p.c. Deb.	90–92	..	3 16 1
15,000	10	Aug. 27	10	North Middlesex 10 p.c.	19½–20½	..	4 17 6
55,940	10	,,	7	Do. 7 p.c.	13–14	..	5 0 0
300,000	Stk.	Apl. 29	8	Oriental, Ltd.	140–143	..	5 11 11
60,000	5	Mch. 27	8½	Ottoman, Ltd.	6–6½	..	6 3 1
398,490	5	Apl. 29	7	Primitiva Ord.	5⅞–6⅛	..	5 12 0
796,980	5	July 30	5	Do. 5 p.c. Pref.	4⅝–5⅛	..	4 17 7
488,900	100	June 1	4	Do. 4 p.c. Deb.	95–97	..	4 2 6
1,000,000	10	Apl. 29	8	River Plate Ord.	13¼–13¾	..	5 16 5
312,650	Stk.	June 26	4	Do. 4 p.c. Deb.	92–94	..	4 5 1
250,000	10	Apl. 10	8	San Paulo, Ltd.	13⅜–14	..	5 14 4
125,000	50	July 1	5	Do. 5 p.c. Deb.	49–51	..	4 18 0
135,000	Stk.	Mch. 12	10	Sheffield A	245–246	..	4 1 4
209,984	,,	,,	10	Do. B	244–246	..	4 1 4
523,500	,,	,,	10	Do. C	243–245	..	4 1 8
70,000	10	May 29	10	South African	13–14	..	7 2 10
6,429,895	Stk.	Aug. 13	5/6/8	South Met., 4 p.c. Ord.	120–122	+1	4 7 4
1,895,445	,,	July 15	3	Do. 3 p.c. Deb.	84–86	..	3 9 9
209 820	Stk	Aug. 31	8	South Shields Con. Stk.	152–154	..	5 3 10
605,000	Stk.	Aug. 13	5/6/8	S'th Suburb'n Ord. 5 p.c.	115–118	+1	4 10 4
60,000	,,	,,	5	Do. 5 p.c. Pref.	117–122	..	4 2 0
117,058	,,	July 15	5	Do. 5 p.c. Deb. Stk.	120–125	..	4 0 0
502,310	Stk.	May 14	5	Southampton Ord.	108–113	..	4 8 6
120,000	Stk.	Aug. 13	6¼	Tottenham } A 5 p.c.	132–137	+5	4 18 6
398,940	,,	,,	5¼	and } B 3½ p.c.	105–108	..	4 17 3
149,470	,,	June 26	4	Edmonton } 4 p.c. Deb.	100–105	..	3 16 2
182,380	10	June 12	8	Tuscan, Ltd.	10–10½	..	7 12 4
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	99–101	..	4 19 0
193,742	Stk.	Aug. 27	5	Tynemouth 5 p.c. max.	104–105	..	4 15 3
255,636	Stk.	Aug. 27	6⅛	Wandsworth } B 3½ p.c.	124–129	..	5 0 9
79,416	,,	June 26	3	and } 3 p.c. Deb. Stk.	73–78	..	3 16 11
845,872	,,	Aug. 27	5⅛	West Ham 5 p.c. Ord.	100–103	..	4 19 6
185,000	,,	,,	5	Do. 5 p.c. Pref.	118–123	..	4 1 3
228,300	,,	June 26	4	Do. 4 p.c. Deb. Stk.	100–105	..	3 16 2

Prices marked * are "Ex div." † Next dividend will be at this rate.